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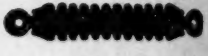
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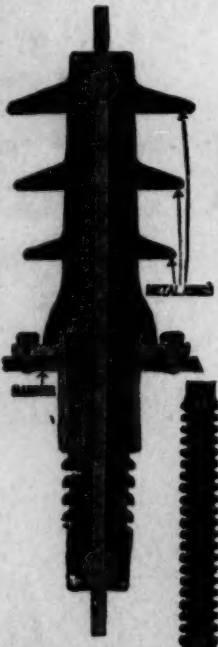
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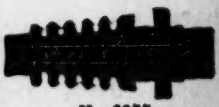
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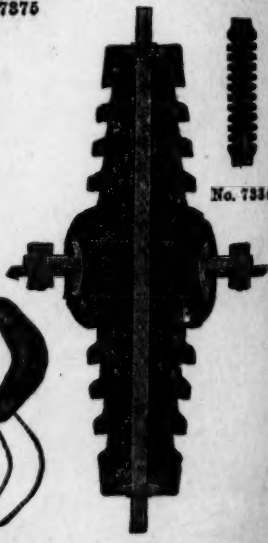
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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE BATTLE CRUISER

By COMMANDER E. F. EGGERT, C. C., U. S. Navy

A great desideratum in building up a fighting fleet is economy in the expenditure of money and men. It is hardly to be expected that all such expenditures could be so made that all are represented in a general action, and one measure of the efficiency of a fleet is the percentage of the total expenditures that are then available.

There will always be special classes of vessels used for special purposes, which cannot be used for fighting, in a fleet action, and they will require men that are therefore not used in battle. There are, on the other hand, vessels that will always be valuable in a general action, such as the battleship, the destroyer, and the submarine—real fighting ships—and we might say that their crews are fighting men. How many of the others though are non-combatants?

Are cruisers fighting ships? To be sure, a cruiser will fight a cruiser or a vessel inferior to herself, but she is wasted capital in a general action, as she cannot inflict damage on a capital ship. The same may be said, to a large extent, of the battle cruiser; indeed it might be asked, is the battle cruiser intended to fight in a general action?

This is usually answered in the affirmative, and it is probable that the first intent was that the battle cruiser should be employed in a general action as a battleship, though of course in a special organization, such as a fast wing. That this is, however, the

present idea, is to be doubted, and that such ships, in action, can be considered as anything more than inferior battleships is open to question.

Cruisers have always been required for purposes other than use in a fleet action, and even in the days of wooden ships, when the only essential difference between the type used for fighting and the type used for cruising was a matter of size of ship and numbers of guns, the cruiser type was used strictly for the special work of its type, and was rarely employed in a general battle. It is likely, however, that this was due more to the fact that sufficient numbers of the type were never available, rather than to an idea that the type was unsuitable for fighting.

Modern cruisers, even the battle cruiser, differ in a much greater degree from the type that has been accepted as the most suitable for fighting in a general action, and it can hardly be denied that in an engagement of battleships the cruiser type, as exemplified by the modern scout, and to a less degree by the battle cruiser, could not be used for heavy work.

It becomes then a question how much money we can afford to spend for a type of ship that should be on hand in considerable numbers, and yet is not available to be drawn into the line of battle for work against the main body of the enemy fleet. In the long run, it always means that money expended on such ships means less money available for fighting ships.

It seems hardly necessary to argue that if all the ships used for scouting and screen purposes could also be effectively used in action against capital ships, their value would be greatly enhanced, and money expended to build them would be not only more wisely expended, but also more easily obtained.

Let us therefore examine into the reasons why the present ships of these classes are not fit for fighting capital ships, and see if some method cannot be suggested to overcome the handicap under which they fight.

The scout cruiser need hardly be investigated at all, since its weaknesses in action are well known. With no protection at all against the battery of a battleship, this vessel also lacks offensive power suitable for use against a capital ship. Its 6-inch battery need not be expected to make any impression on a capital ship, even at short range, and at long range it could not even reach.

With the battle cruiser the question is not so easily answered, although demonstration is not difficult. This vessel cannot be pitted against a battleship of her own date at close range, since she has insufficient protection against a battleship battery at short distances. Even under the most favorable circumstances the 5-inch belt will fail to keep out a 14-inch projectile, and the ship might, therefore, at short ranges, say up to 10,000 yards, be considered entirely unarmored, as far as a battleship battery is concerned.

It is also to be considered that the battle cruiser lacks a sufficient number of guns to fight on equal terms a battleship of her own date, and it will hardly be argued that she will nevertheless be useful against older ships. That is not the aim of naval design.

When we consider fighting at long range, the battle cruiser is not so hopelessly outclassed, though still, on account of the less numerous battery, at a disadvantage. Before going farther, it will be well to define the term long range. It might well be that at, say, 15,000 yards the armor of a battle cruiser will be relatively more effective; that is, the 5-inch belt will keep out a greater proportion of 14-inch projectiles at that range than it would at short range. On the other hand, the battleship armor also gains in effectiveness at such a range, and it can still be said that as compared to the battleship the battle cruiser is unarmored.

There is, for any kind of gun, a range at or beyond which the angle of fall is so large as to make a glancing blow on an armored deck practically impossible. This angle may be 30°, or it may have to be as great as 45°. Then, if the gun has a sufficiently large caliber, penetration of the armored deck becomes possible upon a hit being obtained. It might be stated as a general proposition that for the calibers used nowadays and for the decks as at present fitted such penetration is practically sure with angles of fall of 30° or more. With angles of fall between 15° and 30°, penetration is more or less uncertain, and below 15° practically impossible.

If, then, we consider as long ranges those at which penetration through the armored decks becomes easily possible, when a hit is obtained, such ranges, with guns now used, must be more than, say, 16,000 yards, and in most cases must be well over 20,000 yards.

At such long ranges, the battleship is reduced to equal terms with the battle cruiser, as far as the decks are concerned, assuming that considerations of weight have made it impossible to give the cruiser the same weight of decks as is usual with battleships. This, by the way, is the weakest feature of the battleship, and with the present type it is most difficult, and one might almost say impossible, to fit decks strong enough to withstand plunging fire.

It does not need to be pointed out that at such ranges the side armor of either type of ship is practically a negligible quantity, since the width of the target, in the line of fire, is, in the case of the deck, several times as great as in the case of the side belt. Thus, with an angle of fall of 30°, the target offered by the deck is about 100 feet in range, while that due to a belt 8 feet above water is but 14 feet. This is with the ship broadside on, and with any other presentation the difference is greater.

It has often been claimed for the battle cruiser that on account of her speed she can choose her range. That is quite true, but it is of advantage to her, leaving out of consideration a fight with an inferior ship, only to obtain and retain long range, and this seems to have been what was really meant, since the effort was made to give her guns supposedly able to outrange those of her possible opponents. It might here be stated that such outranging is not possible, except as we compare her with older ships, since, aside from the fact that in a contemporary design similar guns might be used, there is, in guns of about the same size, no great difference between their possible ranges at any given elevation, and there need be no limit to the elevation up to the point of maximum possible range, which is much beyond present necessities.

The speed of the battle cruiser, then, in a ship to ship action, is of advantage to her only to avoid close action, which must usually be disastrous to her, and to place her, as far as her protection is concerned, on a par with the battleship. It does not, however, overcome the handicap of smaller battery, so that, other things being equal, a ship to ship action between a battle cruiser and a battleship, both of the present type, must of necessity end in disadvantage to the former. Of course, speed gives the advantage of possible combination of forces against detached enemy units, but this would probably be against an already beaten enemy.

Long range, therefore, offers the only means by which the lightly armored battle cruiser can hope, in action, to give as much as she must take. It will then be in order to investigate the prospects such a vessel would have in such an engagement.

Although assuming equal skill on both sides, long range firing really requires less skill, except in spotting, than in the case of short ranges. This is because the error in range due to a given error in elevation is much less at longer ranges, so much so that at extreme ranges, with high elevations, there might be several degrees error in elevation with no great error in range. It all comes down to a matter of skill in spotting and keeping the range. With equal skill, hitting at long range is entirely a question of chances, and is practically in accordance with the law of probability.

This being so, the question is at once seen to be one of the number of shots that can be fired on either side, in equal times. This also, since equal rates of fire per gun must be assumed, is reduced at once to the simple matter of the number of guns on the two sides, so that, where the battle cruiser has eight guns to the battleship's 12, it is readily seen that it will require at least three of the former to be on even terms with two of the latter, neglecting any superiority in fire control that is inherent in the superior fire concentration of the two battleships. Since battle cruisers cost twice as much as battleships, and require the same numbers of men per ship, it can hardly be said that building battle cruisers to fight battleships is an economical proposition.

Since the battle cruiser must fight a capital ship at long range, and since, at such ranges, vertical armor becomes so small a target as to have a very small chance of being hit, the idea seems to suggest itself to save money and displacement by omitting such side and other vertical armor, and indeed this seems quite logical. In action with a battleship at any range, it would seem that such armor as can be carried would probably be penetrated if hit, and the only reason that might be assigned for carrying it at all is to prevent damage from the lighter guns of small craft, if the vessel were unexpectedly to find herself in close contact with such small craft.

This could not be called a logical reason, as the weight of armor to be carried would be a severe penalty to pay for the chance of accidentally or carelessly running into such an en-

counter. In any case, if the turrets and conning-tower were lightly armored, there could hardly be much damage done in the few minutes necessary for the larger vessel to wake up, and careful hull design could keep it at a minimum. Besides, the same reasoning that requires the armor would make necessary elaborate underwater protection against torpedoes, since there is a pretty fair chance of being in range of a torpedo vessel. This is not done, cannot be done, for obvious reasons, and is very frankly left to chance. It seems clear that most of the armor should be omitted.

The same reasoning that requires the omission of the armor will also indicate the uselessness of armored decks. The vessel cannot fight at short range, at which only the armored deck would be of value. At long range any deck that could be fitted would be penetrated. It seems clear that the heavy weight of decks that are fitted for protective purposes only should be saved.

These two changes would at once make an enormous reduction in the displacement and cost of the vessel, other things being equal. It would appear feasible to reduce the displacement 7000 to 8000 tons without affecting the other characteristics, or to, say, 27,000 or 28,000 tons. Even this might be a high figure, since considerable power will also be saved, for the same speed.

Omitting the protection will reduce the cost of the vessel so much that more ships can be placed in the line to fight against capital ships. This consideration in itself will reduce the handicap under which the vessels must work, although the battery power of the individual vessel is not increased.

The vessels now carry a heavy weight of battery, although the number of guns is small. Consideration of the law of probability, as has been indicated above, shows that the vessels should instead carry a large number of guns, if they are to fight battleships on equal terms. It is clear that they cannot carry a larger number of the same heavy guns without again increasing size and cost. There is then no course open, if the number of guns is to be increased, except to use a smaller and lighter gun. It is then necessary to decide as to the proper caliber and weight of gun such a vessel should carry.

As the greatest possible number of guns is to be mounted, the smallest and lightest gun possible must be adopted. This will be the smallest gun that can be relied upon, at the fighting

range selected, to carry its projectile through the armored deck. On the same weight of battery, and assuming that our present design carries eight 50-caliber 16-inch guns, these could be replaced by twelve 14-inch or by nineteen 12-inch guns of the same type. The number of hits at long range, in a given time, with the 12-inch battery, would be nearly two and a half times as great as would be obtained with the 16-inch battery.

Now, a complete penetration through the protective deck by any large projectile, such as has been considered, should nearly always result in an explosion in a machinery space or magazine, or similar vital space, and every such hit would most likely be a serious matter, whether the projectile were 12- or 16-inch. It would be difficult to show that the larger projectile could produce more serious effects, since in either case the immediate space reached would be placed out of action, and the effects would not be likely to extend much beyond that space. To get effect from a hit, there is, therefore, nothing material to choose between these calibers.

It seems then that the 12-inch battery will give two and a half dangerous hits from one ship, where we obtain only one with the 16-inch battery. There is, under the circumstances, no choice except to adopt the smaller caliber. Incidentally, although this is never a controlling factor, the smaller caliber should be a better weapon against an inferior ship, or against one of her own class.

If the same reasoning is carried farther, it would seem that a 10-inch gun would be even better. There is, however, the question of penetrating power to be considered, and at the necessary fighting range the small caliber would not be likely to give sufficient penetration. We therefore conclude that nothing smaller than the 12-inch gun would be advantageous.

We have now arrived at a type of ship which has the high speed of a cruiser, by means of which she can select and keep a long range, at which she is, from the point of view of protection, on even terms with the battleship, and which also has a battery capable of giving 19 dangerous hits in the same time in which the standard battleship can give but 12. This is, of course, on the assumption that the range is not so great as to prevent a sufficient number of hits before her allowance is exhausted. If our reasoning is correct, we have now designed a ship that *under the given conditions* must be superior to the battleship.

The resulting vessel is, however, still very large and correspondingly costly, and we could not afford to build in great numbers, such as are desirable, seeing that the vessel is needed as a scout and must replace the present scouts as well as the battle cruisers. If the displacement could be cut down to 20,000 tons, the vessel would be much more serviceable as a scout, and, provided the number of guns were not seriously reduced, would still be an ugly customer for a battleship to fight at long range, especially considering the larger number of ships that could be provided at the reduced cost of the smaller units. This smaller size could be somewhat approached by reducing the speed, but this is a doubtful expedient, and the desired result can be better obtained by using a shorter gun.

We have assumed a gun of 50 calibers length, which will not have an angle of fall exceeding 30° except at a range of more than 25,000 yards, if the long-point projectile of standard weight is used. As the number of hits that could be made at such a long range is probably not great enough to produce results, it will be necessary to reduce the range to, say, 18,000 yards. A 12-inch projectile of 2000 foot-seconds initial velocity will have, at 18,000 yards range, an angle of fall of about 30°, and a remaining velocity of about 1200 foot-seconds, which is most likely sufficient to give penetration through a 3- to 4-inch deck. Such conditions can be obtained with a gun of but 35 calibers length, the weight of which would be but half that of the longer weapon. As the weight of the mountings would be correspondingly light, twice the number of guns could be mounted in the same ship, or, what is more to the point, the required number can be mounted in a smaller ship, of the limited size we have been considering as desirable. This is done without sacrificing the speed to any great extent, although to avoid abnormal power in the small ship, the speed should be cut to, say, 32 knots.

The following would then be the general dimensions and chief features of the suggested design:

Length, 650 feet.
Beam, 76 feet.
Draft, 28 feet.
Displacement, 20,000 tons.
Speed, 32 knots.
Power, 100,000 I. H. P.

Battery, sixteen 12-inch 35-caliber guns.
Four 4-gun turrets, with 2-inch sides, 3-inch fronts.
Conning-tower of 3-inch armor.
No other armor, no armored decks.
Ammunition, 300 rounds per gun.
Oil supply, normal, 2000 tons.

There would be no torpedo outfit and no secondary battery. These would appear to be out of place on a vessel of this character. The latter, for use against light craft, is replaced by the light 12-inch battery, and, if desired, there could be supplied for this purpose a thin-walled projectile of about half the standard weight.

Needless to say, a vessel of this kind requires good visibility to develop its full usefulness against capital ships, though it should be within the limits of possibility to develop means of controlling the fire, somewhat in the same way as fire control is practiced ashore. This could probably only be done to a limited extent and under favorable circumstances. Thus, for instance, the battleships being engaged at shorter range, they might have a special fire control party to spot for the cruisers. Many other methods, more or less undeveloped, might be suggested, but of course good visibility makes these vessels independent, which is a great advantage.

A partial range table for the gun described may be interesting:

R	ϕ	ω	V_ω	t
18,000	22° 15′	30°	1195	40
19,000	24 0	32	1195	44
20,000	26 15	35	1200	47
21,000	28 45	38	1205	51
22,000	31 30	41	1215	55
23,000	35 0	44	1230	60
24,000	39 15	48	1260	65

It will be seen that the angle of elevation has great relative intervals, so that errors in pointing will have correspondingly small effect, and so will differences in jump, roll of the ship, and other causes of dispersion. As is well known, at long ranges the dispersion in range decreases, so that, given good fire control, the vessel ought to make good practice at these ranges. At any rate, even if no more than 1 per cent of this is attained, the result, before the allowance is exhausted, would be 48 hits with 12-inch shell, most of them striking on the armored deck of the

enemy, under conditions that would make complete penetration of the deck and explosion within the vital spaces nearly certain.

It is not by any means intended to convey the idea that the cruiser described can take the place of the battleship, or that, if such vessels were built, the battleship would become unnecessary. The latter must always remain as the one vessel which, under any conditions of weather, can successfully stand up and fight any surface vessel of the enemy, provided only that she can come within range. The cruiser described, being an amalgamation of the scout cruiser and battle cruiser types, will do the necessary scouting and screen work of these types, and will finally, on the great day of battle, when all the forces possible must be made available, be ready to take her place in the line and fight the enemy battleships, after having, in all probability, been previously used to bring the enemy to action, by destroying his screen, his auxiliaries, in fact, by delaying the battleships themselves, on account of the tremendous fire they must receive without adequate return fire, until they turn to defend themselves. No success is however possible without the battleships, which alone can sustain action at close range and prevent the enemy from breaking through.

The battleship is the only vessel that can never be caught at a disadvantage, assuming equal numbers, as long as she can get within sufficiently close range. The cruiser, on the other hand, must not be caught at close quarters, and must choose her conditions. These circumstances might be construed into a great handicap for the cruiser, and indeed they are so; but is it not the province of strategy to overcome such difficulties, to choose conditions favorable to oneself, and, if possible at the same time, unfavorable to the enemy?

The numbers of these vessels that might be required would be determined on the basis of their use as scouts, and would be quite large. The use of these vessels against capital ships might even be considered incidental, yet we would have the satisfaction of knowing that, when action is joined, they would not be an encumbrance, they would not need protection, their crews would be fighting men instead of non-combatants, the money invested in them would not be an extra outlay for special purposes only, but would become actually available in action; in short, we would realize in one more type of vessel the kind of fleet efficiency and economy desired.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MISSION OF AIRCRAFT WITH THE FLEET

By Lieut. Commander H. T. Bartlett, U. S. Navy

The following is an attempt to point out the importance of aircraft for the navy, and to discuss briefly the duties which they can perform. After some experience, both at home and abroad, I have been struck with the suspicion, and, in some cases, downright antagonism, with which some officers and others in authority among the Allied nations regard all naval aviation.

This has been carried to an extent which has seriously handicapped the flying personnel in carrying out duties outlined below; both because of failure to supply material and personnel, and also a general restriction of all aerial operations.

A great many officers who are far-seeing and progressive believe in the future of aviation, but they have only the haziest ideas as to what aircraft should and can, do.

Aircraft, due mainly to the reliability of the present-day motor and their large cruising radius, have now reached a point where, with skilled personnel, they can carry out all the duties outlined below.

Any fleet which has a number of aircraft squadrons will have a tremendous advantage over one which is not so equipped. We must get carriers in our fleet and aircraft bases at strategical points or we will invite disaster when the next crisis comes.

The following duties, in order of importance, are those which should be performed by naval aircraft:

I. Bombing enemy's men-of-war and bases. Shooting up bridges, tops, balloons, etc., with cannon and machine-guns. Attack with torpedo-planes.

II. Protection of own fleet from hostile aircraft.

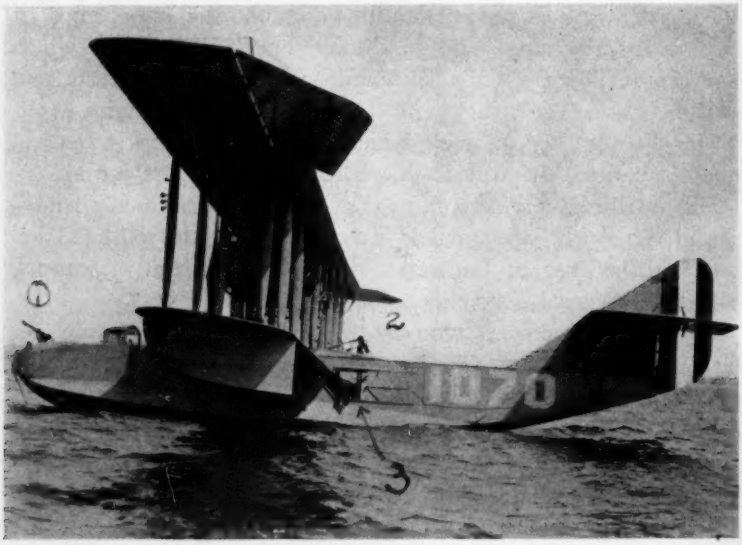
III. Scouting.

IV. Reporting on movements of enemy over smoke screens, in low visibility and over the horizon.

V. Detecting mine-fields, torpedoes and submarines.
VI. Spotting.
VII. Escort.

I. BOMBING ENEMY'S MEN-OF-WAR AND BASES

All offensive action must be carried on by heavier-than-air craft until a practical non-inflammable gas is in use for lighter-than-air craft. At present, dirigibles are easy targets, as one in-

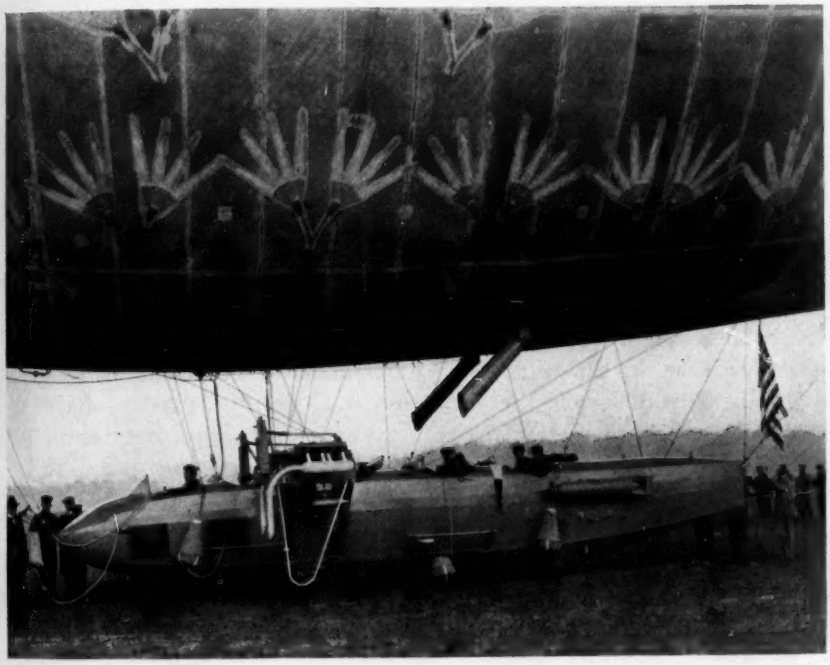


U. S. N. "H-16" BOAT, SHOWING "ALL AROUND" ARC OF FIRE WITH FOUR SEPARATE GUN MOUNTS. ONE, TWO OR THREE GUNS CAN BE MOUNTED ON EACH.

cendiary bullet will set them in flames. They must keep away from hostile aircraft.

Offensive action against surface craft was not of much use in the war, but will become increasingly important, and, it is believed, to an extent that will revolutionize the construction of men-of-war. The reasons for the limited number of successful air attacks on vessels were: Lack of opportunity, small size of bombs, poor bomb sights, untrained bombers, insufficient number of planes and material, and a poor development of aerial strategy and tactics.

Some good work was done against submarines, and one R. A. F. Squadron (No. 217) sank at least two German destroyers, using DH_8 and only 230-pound bombs. A Handley Page Squadron (No. 214) that was operating from our aerodrome at St. Inglevert was dropping 1650-pound bombs. They were loaded with about 1100 pounds of T.N.T., as against only 29 pounds for 14-inch A.P. shell. If heavy bombs were made



U. S. N. NON-RIGID COASTAL DIRIGIBLE, SHOWING ONE BOMB ON SIDE OF CAR.

armor-piercing, they would sink any but capital ships and undoubtedly put dreadnoughts out of action.

Bombing campaigns would be carried out by large bombers, such as Handley Page, getting off a large flush deck carrier; by two-seaters, such as DH_s, also operating from a carrier; and by large seaplanes hoisted overboard from a carrier. Of course, any type could operate from a shore base if the enemy were within their cruising radius. Shore bases, while necessary for supplying material, repair, etc., and for protection of the coast,

do not take the place of carriers. Bases have the same fault as fixed coast defences—the enemy will always "come where they ain't." Carriers are like railroad artillery, they can always meet the enemy no matter where the attack comes from, and, in addition, can accompany the fleet and attack as well.

If hostile aircraft are to be encountered, the large bombers, seaplanes and torpedo-planes *must* be, and the two-seaters *should* be, convoyed by fighters for day work.

All "day bombing" should be formation work, and should be concentrated.

With the present inaccuracy of anti-aircraft fire from ships, bombers could go over as low as 4000 feet in the daytime. At night, both bombing and torpedo work are much easier, as surface craft can generally be seen in any but the darkest nights, whereas aircraft are invisible and could go over as low as 2000 feet.

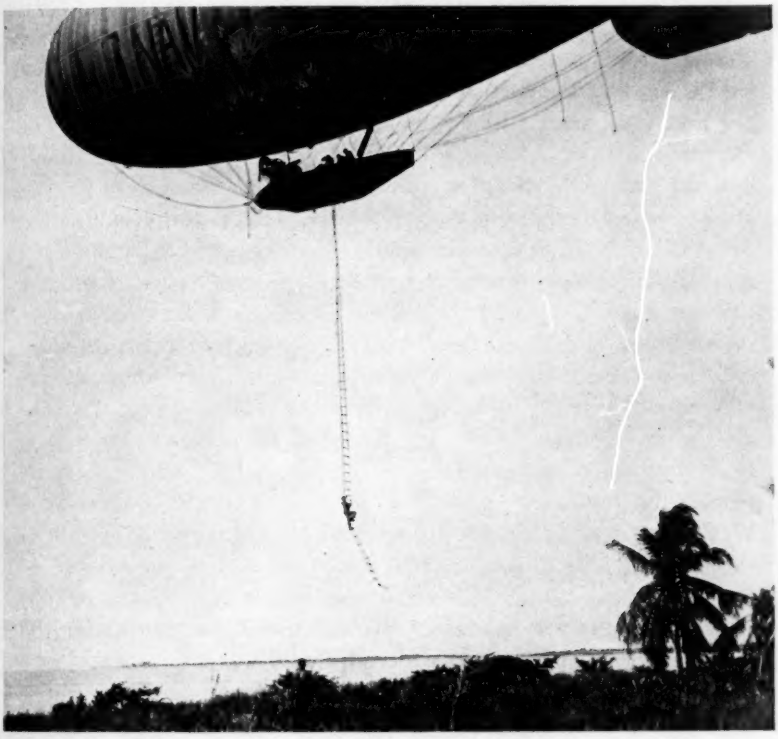
Bombs must be suited to their objectives just as projectiles are. Against capital ships and concrete, the largest possible bombs should be used. As already stated 1650-pound bombs were used in the war, and 3300-pounders were being experimented with when the armistice was signed. Against light cruisers, destroyers and bases not under concrete, a number of smaller bombs would be more effective; the 230 and 520 were mostly used. Against personnel, a large number of small bombs with good fragmentation, such as the 20-pound Cooper, are the best.

For action against surface craft and land objectives, heavy case bombs should be used, as the destructive effect of the fragments is important; whereas against submarines, light case with a correspondingly larger amount of explosive should be used, as the force of the explosion is the only consideration. For both submarine and surface craft bombing, a delayed action fuse is necessary; in the one case to get under water, and in the other (coupled with a heavy armor-piercing nose) to get through the upper decks.

With the accuracy of our new sights and the application of proper tactics and material, the importance of the future of bombing cannot be overestimated.

Gunnery work from aircraft against any enemy except other aircraft is secondary to bombing, but undoubtedly much damage

could be done by both single-seater and two-seater fighters against bridges, tops, etc., with machine-gun and cannon. The 1½-inch automatic cannon now in use and the 3-inch semi-automatic now being constructed, will greatly increase an aircraft's offensive powers.



U. S. N. COASTAL DIRIGIBLE SHIFTING CREW WITHOUT LANDING.

There is undoubtedly an important use for torpedo-planes, especially for night work. It is understood that in recent maneuvers six British torpedo-planes attacked destroyers at 25 knots and made four direct hits.

II. PROTECTION OF OWN FLEET FROM HOSTILE AIRCRAFT

As the offensive use of aircraft outlined in I is increased, there must be a corresponding increase in defence. There is no doubt that the primary defence against hostile aircraft is fighting air-

craft of your own. These give a much greater protection than is possible with anti-aircraft fire, which for many reasons is not nearly as efficient from ships as ashore. Fighting aircraft not only protect vessels from direct attacks, but if in sufficient numbers and properly handled, should prevent the enemy's planes from carrying out any of their duties, such as scouting, escort, spotting, etc.

There was no general aircraft fight at sea during the war, for the reason that the British did not realize the value of planes with the fleet until after Jutland, and never had another chance. The Germans did not develop seagoing aircraft sufficiently to attack, and the Zeppelins were too vulnerable. Both sides were getting ready for a very large aircraft offensive in connection with their fleets towards the end of the war. The British had a number of aircraft carriers with a large number of planes, converting some of their largest ships for this use. In addition, they had planes on all battle and light cruisers, and were putting them on some of their dreadnoughts. In October, when they thought the enemy's fleet was coming out, they were concentrating all available planes at their North Sea bases. The Grand Fleet was to be accompanied by an overwhelming number of aircraft (many hundred), both for protection against Zeppelins and large bombers, to attack the enemy, and for the other valuable duties of scouting, spotting, etc., which could best be performed by aircraft.

This engagement was only prevented by the mutiny in the German Fleet when it was ordered out in October, 1918.

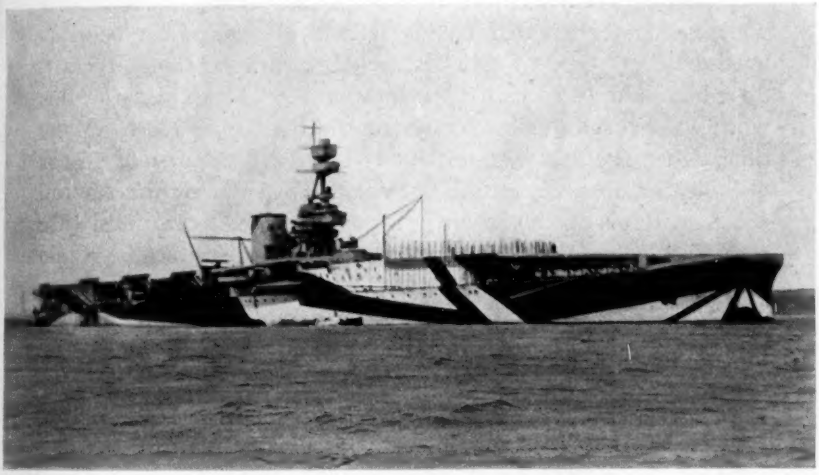
Efficient fighting aircraft are at present single- and two-seater, light fast planes, but undoubtedly in the future there will be a large flying boat which will be armored around the vital parts, and will carry cannon as well as machine-guns. French flying boats are already carrying 3-inch guns. This craft will have no "blind spots," and will be able to put out such a volume of fire that no small fighter can get in on her.

Lighter-than-air craft should make formidable fighters, owing to their stability and the heavy armament they can carry, but only after a non-inflammable gas is adopted.

Aircraft in contact with the enemy must keep always in a proper formation. This is the secret of successful aerial fighting and bombardment.

III. SCOUTING

For scouting and long distance reconnoissance aircraft are far ahead of surface craft because of their great speed. We now have seaplanes with a radius of 1200 miles. It is easy to see the efficient work a squadron of such planes could do with their speed of 60 miles per hour, coupled with efficient radio work. Dirigibles are also valuable in scouting, but at present are more liable to be weather bound than seaplanes, as the latter can now go out in nearly any weather.



H. M. S. "FURIOUS," USED AS AN AIRCRAFT CARRIER. 32-KNOT BATTLE CRUISER WITH TURRETS TAKEN OFF.

For scouting near the fleet, say up to 150 or 200 miles, the two-seater bombing and fighting planes could also be used, operating from the carriers.

Many valuable reports as to the movements of the enemy were made both from lighter- and from heavier-than-air craft.

Scouting altitude and distance (distance between planes) depends upon the visibility and the type of craft that it is expected to meet. It ranges from 1000 feet altitude and a few thousand yards apart for submarine search, to several thousand feet altitude and a 50-mile or more distance for surface craft. In clear weather, high altitudes and greater distances give the most efficient results. Often it is necessary to come down very low to get under the clouds or low visibility. Often it is possible to go

over or around a rain-squall or mist, and still have good visibility. If fog is encountered, it should always be run away from, or if in a proper place, a landing made before it closes in. On any patrol, if fog or heavy clouds are encountered, different altitudes, determined beforehand and at least 500 feet apart, should always be taken at once to avoid collision.

IV. Reporting on Movements of Enemy Over Smoke Screens, in Low Visibility and Over the Horizon

Reporting enemy's movements overlaps scouting, but reports when in contact or almost in contact with the enemy can be made by nearly any type of aircraft including heavier-than-air craft, dirigibles and balloons. The great value of aircraft for this work was proved in many maneuvers in the Grand Fleet. Many times when the fleet was absolutely blinded, due to smoke, poor visibility or distance, all the information desired by the admiral was sent down from the air. Types of ships, formations, base courses, changes in base courses, etc., are easily seen. Radio telephones should always be used for all communication work up to their distance limit, and then radio telegraph. Visual signals are only secondary in case of radio failure.

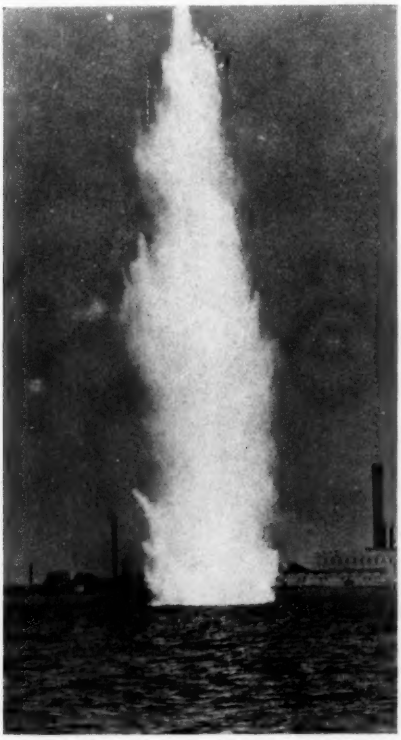
V. Detecting Mine-Fields, Torpedoes and Submarines

In detecting mine-fields and submarines from aircraft, two factors must be considered: the clearness of the water and the condition of the atmosphere. Ability to see under water varies with these two factors. Under the most favorable conditions, such as can be found in the Caribbean, very clear water and a strong sun overhead, it is possible to make out a shape over 100 feet under water. In muddy water, such as the Chesapeake in the spring, nothing can be seen a foot under the surface, and under-water visibility varies between these two conditions.

In general, in blue water, mines can be picked up some fathoms under, especially if there is a bright sun behind, and submarines to a greater depth. Of course, submarines light or awash are easily seen and the **V** wake from a periscope is visible a long distance in moderately smooth water.

The wake of a torpedo is easily picked up, and if the aircraft is connected with the ship control by telephone, directions for avoiding it are of great assistance.

For detecting submarines, mines and torpedoes, dirigibles and balloons are probably more efficient than heavier-than-air craft, owing to their ability to stay in one place, and their greater ease of observation. A great deal of this work was done in the war by all three types of aircraft. Mine-fields and floating mines were reported frequently, and many submarines discovered and attacked, or reported to surface craft.



DETONATION OF AIRCRAFT DEPTH BOMB.

VI. SCOUTING

It is thought that two new factors when properly developed will mean a great deal to gunnery in the fleet. These are the use of star shells at night and aircraft spotting by day. The former was developed by the enemy on the Belgian coast. Star shells as large as 8 inches were used both against aircraft and men-of-war. The latter was brought to a high state of efficiency for

land work on the Western front, practically all efficient long-range shooting being controlled by aircraft.

The Grand Fleet was using aerial spotting for long-range work and an efficiency of at least 300 per cent higher was obtained from aerial spots than from ship spots. Our latest 14-inch 50-caliber gun can shoot over 28,000 yards, and undoubtedly will open fire at at least 25,000 yards in the future. It is not believed that ship spotting can be accurate at over 18,000 yards, whereas aircraft spotting is efficient for any distance and is not affected by smoke screens.

112-, 230- AND 520-POUND BOMBS.

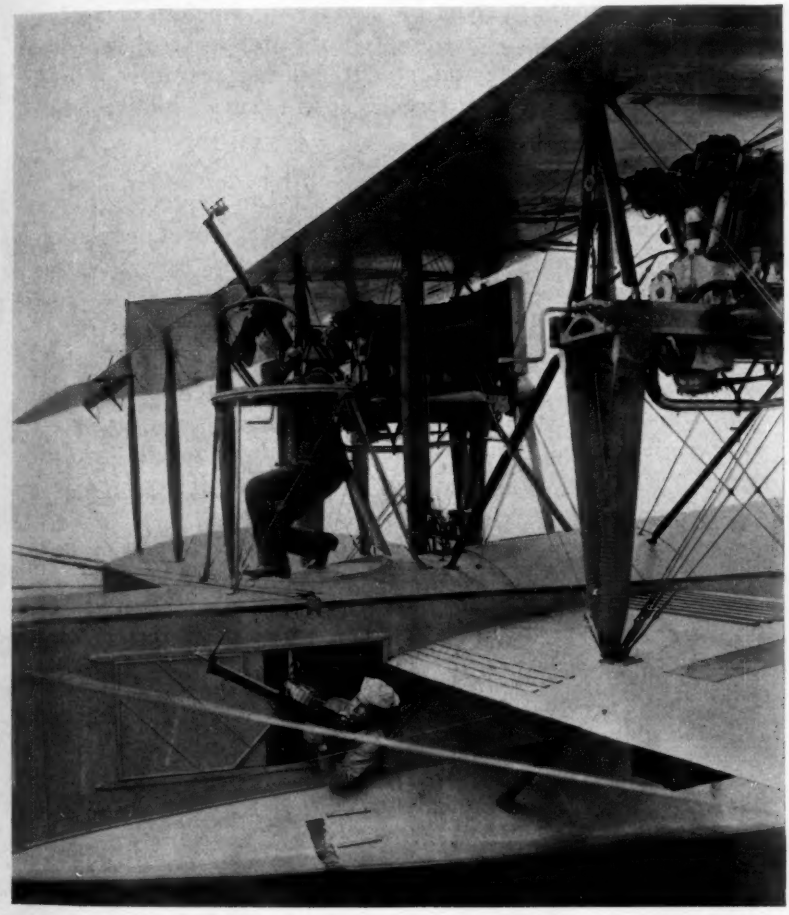
Kite balloons have the great advantage of direct telephone communication, but the disadvantage of giving away your position to the enemy. They also have a bad whip when a salvo is fired, and cannot be used in bad weather.

Dirigibles seem the best aircraft for this work, using radio telephone, but they also are liable to be weather bound.

Heavier-than-air craft are handicapped by the difficulty of keeping the plane in a position such that the observer can always see the target. Planes having the best visibility (flying boat with a front cockpit) should be used and radio telephone for

communication. This should be connected with plot, and the gunnery officer connected in with one earpiece.

The altitude depends on conditions of visibility. In general, from 1000 to 5000 feet.



U. S. N. "H-16," SHOWING THE TOP AND ONE SIDE TAIL GUNS.

The procedure would be as follows for front cockpit boats:

(a) Planes leave the carrier (or report from base) 15 minutes before opening fire, and get the altitude that will give them the best visibility; in clear weather, about 3000 feet.

(b) Test out radio phones. Must be able to talk clearly with plot. Test out radio telegraph and other secondary signal systems in case the phone fails. Signals that have been used with varying success are different colored smoke puffs, maneuvering the plane, and flags and streamers.

(c) Notify plane to stand by three minutes before first salvo. Plane will then maneuver so as to pass over firing ship in line of fire, flying towards the target, at the instant first salvo is fired.

(d) Notify plane which target ship is firing at, and keep him informed if aim is shifted.

(e) Notify plane of approximate range.

(f) At instant of firing sing out "fire" to spotter so that he does not have to strain his eyes watching for the blast or splash.

(g) Plane should pass over firing ship as first salvo goes and spot for first salvo in this line of flight. Spotter always uses standard terms, as "up 100, right 02," or "down 100, left 3." Spotting must be quick and accurate, and when using radio phones should be in as soon as the ship spotter's corrections. Only *trained* spotters should operate. A good spotter with some air experience should increase spotting accuracy several hundred per cent, whereas the best aviator in the world, if not an expert spotter, would be sure to make a mess of things.

(h) After first spot is out, turn to right or left, and fly back and forth in front of the firing ship, always turning towards the target. In order that each turn does not increase the distance from the firing ship, and so decrease the strength of the phone and get into the trajectory, each leg must incline towards the firing ship. As each "fire" comes over the phone the pilot can kick the nose toward the target and then back again after the spot is out. This prevents the wing from obscuring the observer, and by maneuvering in this manner every salvo should be spotted. Care must be taken not to get too far from the firing ship, or the plane, unless very high, will get into a dangerous part of the trajectory. For a 14-inch 50-caliber, at 20,000 yards, the maximum ordinate is 4600 feet, and for 25,000 yards is 7300 feet. A rough rule, good up to an ordinate of about 2000 feet, is that the range is equal to the ordinate times the cotangent of the angle of elevation. For instance, for a 20,000-yard trajectory, then

$$X = 1000 \cot 12^\circ\ 57'.5$$
$$= 1000 \log 10.63803$$
$$= 1445 \text{ yards.}$$

From this it can be seen that if a plane flew 1445 yards in front of the firing ship at 1000 feet, she would get into the trajectory of the projectile. The data for this formula can be obtained for any gun from the range tables, and will always keep the plane above the projectile, as it is accurate for the straight path and thereafter the curve is down, or away from the aircraft. A safety allowance should be added to this to provide for high shots and air disturbance.

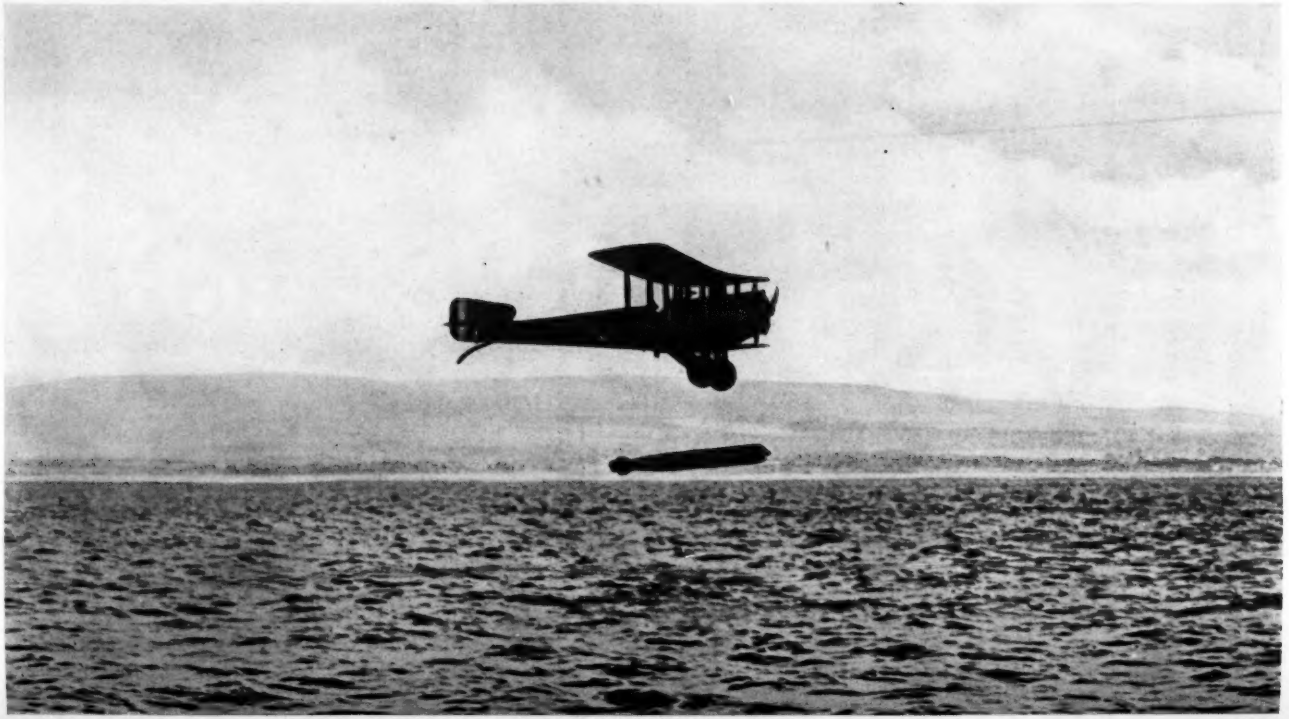
VII. ESCORTS

Escorting surface craft and submarines has been one of the most important duties performed by aircraft. There were almost no cases of submarines attacking a convoy when there were aircraft present, as the German commanders always submerged when a plane was seen or heard. The Dutch and Channel convoys, and, towards the end, the French coastal convoys, were nearly always escorted by planes as well as surface craft.

Dirigibles are more suitable for convoying than planes, owing to the greater ease with which they can remain over the convoy. This obtains always, provided no contact is made with the enemy's aircraft, when dirigibles would probably be shot down.

Pilots must remember that the mission of escort craft is to get the convoy to its objective, and must not leave their station for any reason except motor failure. There is no excuse for chasing an enemy sighted on the horizon, and then have a hostile submarine come up and get several ships.

The tactics of escorting convoys, scouting, searching for mines and submarines, etc., were brought to a high state of perfection under Commander Kenneth Whiting, U. S. Navy, at our North Sea Air Station at Killingholme. The deep sea (submarine and mine search) and the convoy squadrons were always in the air; the latter escorting convoys having as many as 150 ships. About 6200 ships were convoyed by our planes from this one station, in the less than four months of our régime, with only one ship sunk, and this when the escort planes were down with motor trouble. This was done in the most active submarine zone, the East Coast of England. Letters from the Admiralty and the Vice Admiral commanding that part of the coast, testify to the British Navy's high opinion of the importance of this work.



ADMIRAL FISKE'S IDEA BEING PUT INTO EFFECT.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE TORPEDOPLANE

THE NEW WEAPON WHICH PROMISES TO REVOLUTIONIZE NAVAL TACTICS

By HENRY WOODHOUSE

Author of The Text-Book of Military Aeronautics, The Text-Book of Naval Aeronautics, The Aircraft's Part in Beating the U-Boat, Vice President of the Aerial League of America, etc.

"Among many new devices which the armistice prevented the Royal Air Force from putting into use against the enemy was the torpedo-aeroplane. It is considered to be of even greater potential value than the submarine, and would doubtless have proved astonishingly efficient. The enemy has good reason to be thankful for having escaped this new offensive weapon, which was ready for active service only a little while before the cessation of hostilities. The torpedo-aeroplane is a development of the torpedo-carriers, which were first successfully employed in action by the R. N. A. S. at the Dardanelles in 1915, and were subsequently used against us by the Germans in 1917, when they were thus enabled to sink three of our merchant ships off the South-East Coast. The torpedo carried by torpedo-aeroplanes is of a small size as modern torpedoes go, and weighs half a ton."

The above quotation from the *Illustrated London News* was accompanied by two photographs of torpedoes being dropped from single motored Sopwith biplanes of the type which are launched from British aerodrome ships.

When Rear Admiral Hugh Rodman, U. S. N., returned to the United States after nearly two years of service with the British Grand Fleet, he made two main recommendations, as follows:

(1) That the United States should continue to use submarines for defence;

(2) That the United States should build new types of vessels equipped with aeroplanes able to attack fleets at close range with torpedoplanes.

When Admiral Rodman appeared before the House Committee on Naval Affairs, on January 3, 1919, he spoke further of the torpedoplane, as follows:

It is also unqualifiedly true that we will also have to have entirely new types of vessels, different from any we ever had, to carry aeroplanes, both for scouting and defensive work. It is extremely difficult to hit an aeroplane with any gun we now have.

The British have developed a plane to carry a torpedo. If we had in our fleet ships equipped to carry 15 planes fitted with torpedoes, there is no question that if we could get in close proximity to the enemy's fleet, we could operate very successfully, especially against battleships.

THE BRITISH TORPEDOPLANES

The first account of Great Britain's torpedoplanes was given in the following article which appeared in the London *Daily Mail* for December 27, 1918:

The mystery aeroplanes of the British Navy, which during the fighting were one of its most jealously guarded secrets, have been specially described by an expert who has had full opportunities for studying the craft.

The mystery aeroplane was designed to do from the air more effectively and more swiftly the work formerly allotted to our torpedo-boats. The enemy had devised such successful protection of harbors and ships against our torpedo-boats and submarines that it was only with the gravest risk that we could approach within 30 miles of Kiel and other German fortified ports. But for the newest peril the enemy had no reply.

The news of our discovery of a means of attack that was immune from mine dangers and too swift in its operation to be held off by gunfire reached the ears of the enemy, and is believed, in one quarter at least, to have helped the Huns to the decision of surrender.

Had not hostilities ceased so suddenly these machines would have operated effectively against Kiel harbor and the German warships in their lair. The efficacy of the weapons will be realized when the operation is explained. One of these mystery aeroplanes, espying its enemy, makes a sudden dive from the clouds at 150 miles an hour, levels out at 50 feet above the surface, discharges a torpedo directly at the enemy ship at the right moment, after which the pilot pulls back his joy-stick and disappears into the clouds as suddenly as he appeared. The operation is so swift that the enemy has little chance of training a gun on the assailant. In one of these attacks a British airman torpedoed and sank a Turkish troopship containing 3000 troops.

When the idea was first conceived of having an aeroplane to carry an ordinary torpedo such as is used on the submarine, technical difficulties almost defeated the project, until a northern designing firm got hard at work in conjunction with the Air Ministry. The difficulty was not so much of lifting a torpedo as of ensuring that the action of discharging the torpedo was carried out with accuracy of aim and with safety to the pilot. Experiments were carried out in face of great difficulties and perils.

On one occasion when the experiment of discharging a torpedo from an aeroplane was made, the lightening of the aeroplane had such a serious

effect on the latter that the wings collapsed and the pilot was hurled to sudden death. In another case when the torpedo had been discharged, it hit the water at an awkward angle, and ricochetting over the surface, rose and demolished the aeroplane which had not risen out of the way. This discharging of a torpedo was no light risk when the torpedo was of full size, weighing anything up to a ton—three times the weight of the machine in which Blériot first crossed the English Channel.

A good deal of practice and patience was needed to make torpedo attacks from aeroplanes a success, and it is a tribute to the indomitable perseverance of our naval pilots that they have at length developed some formidable squadrons with special efficiency in this new work. These wonderful aeroplanes can go up from land or from the deck of a ship, and can descend on the sea and float until help is brought by wireless. When the German Fleet surrendered, an aeroplane "mothership" with 20 of these machines in its bosom met the Huns 50 miles out at sea, and had any tricks been tried it would have been simple work for a score of mystery aeroplanes to have leapt into the air and torpedoed the best part of the ships. This mystery or "Cuckoo" aeroplane—so called because of its weakness for laying eggs in other people's nests—is one further testimony to British engineering ability and resourcefulness of our navy.

REAR ADMIRAL FISKE INVENTED THE TORPEDOPLANE

Rear Admiral Bradley A. Fiske, U. S. N., conceived the idea of a torpedo-carrying aeroplane in the winter of 1910-1911 as a means of defending the Philippine Islands, and discussed the idea with the General Board of the navy. He was in charge of the "War Plan Section" of the General Board, U. S. Navy, and in that capacity suggested that the Philippines could be defended against invasion by means of a large number of aeroplanes which would drop bombs on enemy boats going ashore from the transports and on men who might be landed, and that by using aeroplanes of a larger size it would be possible to drop torpedoes from them which would sink the men-of-war and the vessels of the invading fleet.

In April, 1912, Rear Admiral Fiske applied for patent on the torpedoplane, which was granted in July, 1912, by the U. S. Patent Office.

THE ITALIAN EXPERIMENTS OF 1912

The Italians were the first to make experiments in dropping weights from an aeroplane, with a view of evolving a method of launching torpedoes. Captain Alessandro Guidoni, Royal Italian Navy, using a 1910 Farman biplane equipped with floats, made a number of experiments at an Italian naval base in 1912-1915.

He dropped weights first and then small torpedoes. But these experiments were essentially personal experiments due to Captain Guidoni's progressiveness, unsupported by the government, and the work was slow, especially as Captain Guidoni could only give part of his time to this work.

THE BRITISH EXPERIMENTS

In August, 1913, the late Lieut. Colonel Douglas Hyde Thomson, chief of wireless telegraphy of the naval branch of the British Royal Air Force, who was then lieutenant in the Royal Navy, wrote a paper on torpedo-aeroplanes. Captain M. F. Sueter, who was then director of the air department of the British Admiralty, appreciated the value of the idea and in conformity with the practice of the British Navy, which provides that the name of the commanding officer shall appear on a patent application with the name of the author of the invention, a patent application was made in the joint names of Captain Sueter and Lieutenant Hyde Thomson, in March, 1914.

Thereafter experiments were conducted at the Royal Navy Air Stations at Calshot and elsewhere. Numerous experiments were made at Southampton Water. Twin pontoon seaplanes were used. The torpedoes were slung between the two pontoons, as shown in the accompanying illustration. Then twin motored seaplanes were used.

But a great many problems arose and, with the exception of a few enthusiasts, the general opinion was one of scepticism. The planes were too small to carry a large torpedo for any distance and it did not seem possible to make smaller and lighter torpedoes especially suited for this work.

The sinking of a Turkish troopship while at anchor in the Sea of Marmora, in 1915, by a British torpedoplane, created a little more interest in the experiment, but no greater support was given to the work and the experiments were superficial in nature and dragged on slowly, due to lack of official interest.

WHEN THE GERMANS SANK A BRITISH STEAMSHIP WITH TORPEDOPLANE

In May, 1917, those who believed in the potentiality of the torpedoplane and hoped that the Allies would put this device into effect against the German Navy before Germany could build

torpedoplanes were made heartsick by the report that the British steamship *Gena* had been torpedoed by a German torpedoplane.

The torpedoing of the *Gena* by a German seaplane was reported by the British Admiralty on May 2, 1917. The report read as follows:

> The British steamship *Gena* was sunk yesterday (Tuesday) by a torpedo discharged from a German seaplane off Aldeburgh. All hands were saved. Another seaplane concerned in this attack was brought down by gunfire from steamship *Gena* and the crew were made prisoners. The following is the German version of the incident, sent out from Berlin on May 2:
>
> "Yesterday morning a number of our seaplanes attacked some enemy merchant ships off the Thames and sank a large steamer of about 3000 tons. One of our machines has not returned, and it is supposed that it is lost."
>
> In connection with the above, it is stated by the Admiralty that this method of attack was first practiced successfully in August, 1915, by R. N. A. S. pilots, who sank several ships in the Dardanelles by torpedo from seaplanes.

A sketch of one of the German seaplanes that participated in the attack against the *Gena*, showing the pontoon arrangement for holding the torpedo, which was published in a British magazine, shows that the arrangement for holding the torpedo in the German seaplane is exactly like the arrangement on Admiral Fiske's torpedoplane. The torpedo is held between the two pontoons of the seaplane with a bracing to keep the torpedo from moving while the seaplane is flying.

It seems that the Germans continued their experiments and had torpedoplanes at Ostend and Zeebrugge. But they used single motored seaplanes, the speed of which was cut down considerably by the weight of the torpedo. According to reports, on one occasion the German torpedoplanes tried an attack from Zeebrugge on some British destroyers that were shelling Zeebrugge. The report states that the British did not expect to be able to spot the attacking torpedoplanes, but they knew that the Germans had set their torpedoes to be dropped from a given height, not above 20 feet, and the attack would be made from a given direction, and the aviators had had little practice. The British destroyers set up a water barrage across the way from which the German torpedoplanes were to come by firing on the water. This is said to have created an effective water barrage which made the German pilots resolve to turn back.

If this is true the German aviators must have been inexperienced, because it would have been very easy to have gone around the flank of the barrage and attack the destroyers from an unexpected direction.

U. S. EXPERIMENTS

Until 1917 the subject of torpedoplanes was discussed in this country from time to time, but as Mark Twain said about the weather, "Everybody talks about it, but nobody does anything about it," nothing was done to give the United States the torpedoplanes needed to meet an emergency.

Late in 1916 the Board of Governors of the Aero Club of America, after taking stock of the military resources of the United States, came to the conclusion that, owing to our small army and navy and general unpreparedness, the only hope of success on the part of the United States in case of war would be in developing some powerful new instrument which would give us predominance. A committee consisting of Messrs. Alan R. Hawley, Henry A. Wise Wood, Rear Admiral Robert E. Peary, and the writer, made an investigation with the purpose of finding one or more new instruments, the value of which would be so great that they would give predominance to the side which employed them. After looking over the field of inventions, the committee came to the conclusion that the torpedoplane patented by Rear Admiral Bradley A. Fiske in July, 1912, was a revolutionary invention of tremendous possibilities.

The committee then asked Admiral Fiske to deliver an address on the subject, which he did at the Aeronautic Conference held in connection with the First Pan-American Aeronautic Exposition, Grand Central Palace, New York City. Admiral Fiske's address on that occasion is printed elsewhere. It created considerable interest, and, as a result, a fund of $2500 was set aside for the purpose of defraying the expenses of the experiments of developing the torpedoplane. Admiral Fiske was asked to be chairman of a committee to supervise the work of developing the torpedoplane, and he appointed the following as members of his committee: Alan R. Hawley, Henry A. Wise Wood, Rear Admiral Peary, John Hays Hammond, Jr., F. Trubee Davison, Schuyler Skaats Wheeler, Frank M. Leavitt, Lawrence B. Sperry, and the writer.

The committee had the choice between concentrating its efforts in developing large seaplanes and training aviators to drop full-sized Whitehead torpedoes, which weigh 2000 pounds and measure 21 inches in diameter and 17½ feet in length, or to develop a torpedo small enough to be carried by any of the two-passenger flying boats or hydroaeroplanes now in general use. The committee came to the conclusion that, owing to the fact that there were very few aviators in the United States who had any experience in piloting a large seaplane and owing to the time that would be required to train men to drop such heavy weights from an aeroplane, it would be best to concentrate efforts in developing a small torpedo, weighing less than 200 pounds, which could be dropped from the average two-passenger seaplane by almost any aviator. This would make it possible in time of war to press into service for launching of torpedoes almost every civilian, naval, and military aviator who had sufficient experience to pilot a machine.

At first it seemed impossible to develop an automobile torpedo weighing less than 200 pounds, having a range of about 1000 yards at a speed of about 25 knots, but the committee was willing to have experiments carried out regardless of the possibility of failure, and three leading experts on torpedoes promptly took up the work and soon advised the committee that such a torpedo could and would be developed. Before the small torpedo had been perfected, however, large aeroplanes had come into use, and the need for small torpedoes ceased.

CHECKING THE VELOCITY OF FALL BY MEANS OF AUTOMATIC BRAKES

Some years ago I had occasion to discuss, first with Admiral Fiske and then with Allied officers, the advisability of using automatic brakes to check the velocity of fall of the torpedo. This discussion led to considering a number of methods, such as lowering the torpedo by means of a cable. But it was realized that while it would be feasible to lower the torpedo several hundred feet by means of a cable, and its direction could be maintained by means of vanes, and the possible swerving of the torpedo might also be checked by means of vanes, which would hold the torpedo steady excepting in case of sudden turns, the advantage to be gained was not apparent.

Experiments in this direction should, however, be conducted to ascertain just what can be done.

How the Torpedoplane Came Near Being Abandoned

The torpedoplane has had an eventful career. It suffered through scant attention and long drawn superficial experiments without suitable aeroplanes, suitable torpedoes, and proper appreciation of its potentiality.

Naval operations must, of course, be carried out with thoroughly tested weapons and the torpedoplane could not be considered as an available weapon until it had been reported favorably by the ordnance experimental "shops." Unfortunately, the ordnance experimental shops of the Allied countries were not equipped with aeroplanes with which to conduct tests, and air stations did not have torpedoes; and somehow, any proposition to send torpedoes to air stations or send aviators to ordnance testing stations was always sidetracked in transit.

Oftentime the experiments were sidetracked because it was held that the enemy's ships were not operating on the high seas and the only way to reach them was to attack them in their bases. This was held to be impossible because these bases were located within defences, and it was held that torpedoplanes would not succeed in penetrating the enemy's defences. Hence it was deemed impracticable to attempt torpedoplane operations. The advent of the British Air Ministry in 1918, which resulted in placing Captain M. F. Sueter in an important executive position, resulted in the continuation of the experiments on an extensive scale. The torpedoplane "graduated" from the ordnance experimental "shop" and was immediately recognized as a potential weapon, and plans were made to use it extensively against the German Navy, attacking the German ships in their bases.

Factors That Govern Success of Torpedoplane Operations

The main factors that govern the success of torpedoplane operations are:

(1) The use of fast, camouflaged aeroplanes, equipped with mufflers, so that the approach cannot be seen or heard by the enemy until the torpedoplane has arrived within striking distance.

(2) Having an experienced crew, well trained and experienced in the work.

(3) Having torpedoes powerful enough to be effective against the ships to be attacked.

(4) Dropping the torpedo from a suitable height to prevent its being put out of order by a too great impact or of its rebounding and striking the tail of the torpedoplane.

(5) Holding the torpedo in position and dropping it while the torpedoplane is flying towards the ship so that the gyroscope, being started while the torpedoplane is heading for the ship, will direct the torpedo in the direction of the ship. The plane may, of course, change its direction immediately after dropping the torpedo and make its escape.

FUTURE TORPEDOPLANES

The naval seaplane *N C-1*, could easily carry two full-size torpedoes. This flying boat has a wing spread of 126 feet and is equipped with three low-compression Liberty motors of 350 H. P. each. It has a cruising speed of 80 miles an hour, weighs 13,000 pounds unloaded and 22,000 pounds fully loaded.

The British flying boat constructed by Colonel Porte of the Royal Air Force is larger. It is a triplane, equipped with five Rolls Royce motors.

Larger seaplanes are under construction and it is expected that aeroplanes capable of lifting 25 tons will be produced this year and over double that size next year. Larger still will follow.

ONE HUNDRED MILES AN HOUR TORPEDO BOATS!

Some of the transatlantic flyers being planned are to be capable of covering 3000 miles without stopping.

These machines can be converted into torpedoplanes by merely attaching the torpedoes under their planes or at some other convenient place.

And then they become flying torpedo-boats, capable of cruising at a speed of about 100 miles an hour and of crossing the Atlantic within 30 hours!

A crew of half a dozen men will be sufficient to operate such a torpedoplane.

What a marvellous combination of speed, potentiality and mobility!

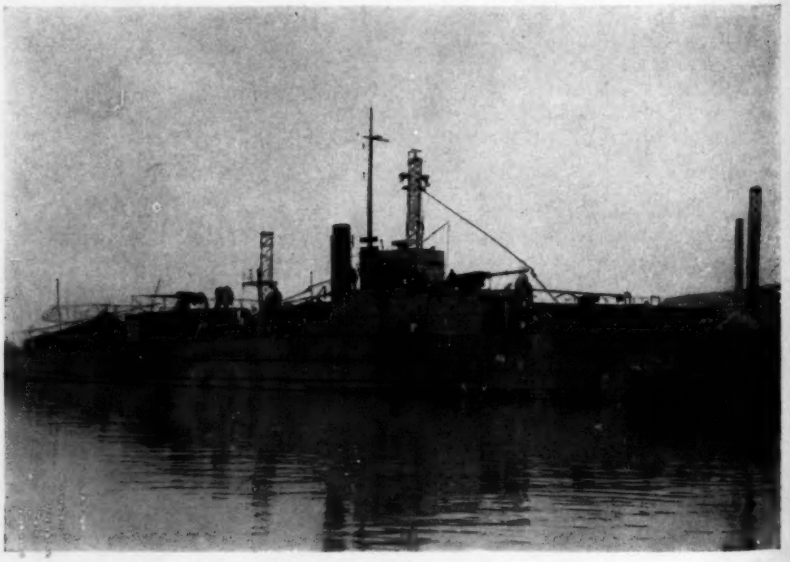
What better weapon can we find for the defence of our coasts and island possessions?

An enemy fleet bent on attack or carrying an invading force would have to contend with large torpedoplanes before it could come within 1000 miles of our shores and with smaller torpedoplanes launched from aerodrome ships, such as are recommended by Admiral Rodman.

Our island possessions will be most powerful as torpedoplane *bases*, almost invulnerable.

Is this not truly revolutionary in its prospective developed stage?

110-Foot Submarine Chaser.



Eagle Class Patrol Boat.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE 110-FOOT SUBMARINE CHASERS AND EAGLE BOATS

By COMMANDER J. A. FURER, Construction Corps, U. S. Navy

The usefulness of naval craft at the lower end of the scale of size and power has been one of the striking lessons of the war. For many years the thought of the naval designer had been directed only toward the production of larger and more powerful types of vessels, whether submarines, destroyers or capital ships. The idea that any surface fighting craft smaller in size than a destroyer could have a place in a well-balanced naval establishment was given up years ago by all first-rate naval powers. The reasoning which led to the abandonment of small craft similar to the former torpedo-boat was correct, from the point of view of the use that could be foreseen for such vessels at that time.

However, the rôle played by the submarine, even in the early stages of the European war, brought about new conditions. The destroyer and cruiser forces of the Allied powers were found inadequate for effectively patrolling the waters of the war zone and for combating the activities of the submarine. Pleasure craft and small commercial vessels of all descriptions were converted by Great Britain to this use, so far as possible, by mounting guns of such caliber as could be carried and as were available. Early in 1915, the British Government placed a contract with an American company for 550 motor boats, for the purpose of augmenting the patrol forces of the British Navy. These boats had the following characteristics:

Length, 80 feet.
Beam, 12 feet 2 inches.
Draft, 4 feet 6 inches.
Speed, 18 knots.
Machinery, two 220 H. P. gasoline engines, built by Standard Motor Construction Company.

The capacity for building engines which was developed in the United States by reason of this contract proved of great value to the navy later on in obtaining similar engines for the 110-foot submarine chasers.

In 1916, the Navy Department began an investigation of the probable resources of the United States in the way of pleasure craft and other small power-driven vessels which would be available for conversion into patrol boats should the necessity arise. A campaign was also started to interest prospective owners of pleasure craft in designing their boats so that they could readily be converted to patrol uses. Naval architects and their clients were encouraged to submit their designs to the Bureau of Construction and Repair of the Navy Department, for criticism before building. In this way some interest was aroused in the subject, but the results, so far as obtaining suitable vessels was concerned, were slight.

The investigation which was made revealed that a surprisingly small number of the so-called power-driven craft would be of real service. The one outstanding disability of most yachts is that they are not seaworthy to the extent demanded of naval vessels. This is due to the fact that the average yacht owner is not interested primarily in a boat which can go to sea in any weather. He is in a position to choose his time in cruising from port to port. Furthermore, seaworthiness under all weather conditions entails the sacrifice of certain characteristics and arrangements of construction which are of more importance to him, such as deck structures, comfortable quarters, easy motion, and appearance.

The second and perhaps equally great disability of many such vessels is that their power plants are usually not reliable for continuous running. This was found particularly true of the gasoline engine installations. The reliable marine gasoline motor of large power and light weight has not yet arrived. The tendency of all yachtsmen is to want a little more speed than the other fellow's boat can make. This has resulted in an endeavor on the part of the engine builders to strive for lighter weight and more revolutions than good engineering, from the point of view of endurance, would dictate. The result is that the large majority of gasoline-driven pleasure craft have engines which are good only for comparatively short endurance. There are, of course, excep-

tional boats that have been designed on the principle of observing such a balance of characteristics as to make for seaworthiness and reliability of power plant.

The conclusions reached from the pre-war study of this subject have been fully borne out by experience with these craft in actual service. Some of the stauncher vessels were sent to the other side, but in general it may be said that the converted yachts which have proved suitable for naval service have been very few in number. Many of the smaller craft have, however, been found useful and necessary for patrol work in harbors and in partly enclosed waters on the Atlantic coast.

When it became apparent that our existing resources of this type of vessel would fall far short of the requirements in case the United States was drawn into the war, the Bureau of Construction and Repair took up the design of a vessel specially adapted for this service. On account of the shortage of steel construction capacity, all of which was needed for building destroyers and merchant vessels, it was decided that the boats would have to be built of wood. As wood construction presented a special design problem, the services of an eminent yacht architect, Mr. A. Loring Swasey, who later rendered invaluable service as superintending constructor for the United States Navy in the New York district, were obtained for this duty in the Bureau of Construction and Repair.

The most important characteristic for this type of craft was considered to be seaworthiness. This characteristic cannot be given to very small boats. On the other hand, in wood construction the limit of size beyond which the hull weight becomes excessive is soon reached. The best compromise was found to be a boat 110 feet in length over all. This length made it possible to incorporate in the design all of the essential service requirements and to make for a thoroughly seaworthy boat.

Considerable pressure was brought to bear from various quarters to build boats of smaller size, on the grounds that such boats could be produced in larger quantities in a given time. While this would have been true, it would have been equally sound to have manufactured air rifles for the army instead of Springfields. Before definitely rejecting the design of the 80-footers, which were built in the United States for England, the opinion of the British Admiralty on these boats was obtained. The comment

of the British Admiralty confirmed our opinion that the 80-footers were not sufficiently seaworthy for general service.

There was practically no choice as to the machinery installation. Steam engines were out of the question, because of the lack of capacity for building light weight propelling machinery in quantity. One make was briefly considered, but the production would at the best have been a matter of tens instead of hundreds of units in the time available. Even as to gasoline engines it was found that there was no choice, as the question of quantity production entered into the problem. It was found that only the Standard Motor Construction Company had both an acceptable engine as to design and suitable capacity for producing the numbers needed. Even at that the production of engines proved later on to be the limiting factor in turning out completed boats.

A triple-screw arrangement was adopted using three 6-cylinder 220 H. P. engines. While speed was not considered the most important characteristic of the boats, an endeavor was made to obtain a maximum speed of 17 knots. Due to the addition of many features which increased the displacement of the chasers beyond the design calculations this speed has not been reached in service, although on trials at the designed displacement the boats came up to expectations in this respect.

The requirement that the boat should be able to go to sea and to stay at sea in any kind of weather was considered the high spot in the design. As to this quality every expectation has been fulfilled. The 110-foot chasers are quick rollers, their period being about five seconds, but this is a characteristic which is fundamental to seaworthiness in a small vessel; otherwise, green seas over the bows become the rule instead of the rare occurrence. Many interesting reports have been received of these small vessels sticking to their convoys when larger escorting vessels were scattered and battered by heavy weather.

The design of the gasoline storage and supply system was given much attention. Any gasoline boat is a potential volcano. No matter how carefully the system may be designed and built—gasoline fuel is a hazard because carelessness is a common human failing. Fortunately, the serious accidents in service have been few. Such accidents as there have been can be traced to failures to observe the precautions that are necessary in dealing with this dangerous fuel. As this article may be read by someone who

has been living on a gasoline-driven boat so long without accident that he has forgotten that eternal caution is the price of safety, the most serious accident which has occurred on a chaser will be briefly recited:

Several months ago a 110-foot chaser was fueling at sea astern of a tanker. In order to accelerate the flow of gasoline the commanding officer ordered the manhole covers of the tanks removed, thus permitting the fumes to vent directly into the boat. This was the first mistake. Then also the radio operator was directed to stand by to receive or to send messages. This was the second mistake. While taking on gasoline the commanding officer should have forgotten that he had a radio outfit on board. The operator received a call and went below to take the message. On completion of the message he opened the motor-generator switch. An explosion followed which killed several men and injured others.

The two principles which underlie all precautionary measures with respect to gasoline are: First, to prevent the accumulation of gasoline fumes inside of the boat; and second, to avoid sparks and open flames in localities where gasoline fumes are likely to be present. The first principle requires the venting of tanks into the open atmosphere, the closing of all doors, hatches and airports while taking on gasoline to prevent vapors given off by the vents and filling pipes from creeping along decks and penetrating through such openings into the boat; keeping the bilges clean and free from gasoline; and inspecting the piping system and tanks frequently to detect leaks. The danger from sparks and open flames in the vicinity of gasoline vapors is obvious. All of these matters are fully covered by regulations and instructions. It seems like an elaboration of the obvious to invite attention to these precautions. If these precautions were always observed a gasoline installation would be practically as safe as a steam installation, but it is human to become careless.

The armament originally contemplated for the chasers consisted of one 6-pounder and two machine-guns. After the design had been practically completed this was changed to two 3-inch and two machine-guns. Later on a depth bomb projector was substituted for the after gun. There was some question as to whether the armament of the chasers would be effective against submarines. A demonstration of the adequacy of the 3-inch gun was afforded at Durazzo where the chasers sank an Austrian

submarine by gunfire. The depth bomb, however, proved to be the most effective weapon of the chasers, as there was seldom an opportunity to use the gun against submarines. It was assumed that a submarine would not consider it worth while to engage in a gun duel with a chaser, as the risk would have been out of proportion to the result which the submarine would accomplish in destroying so small a vessel as a chaser.

The principal characteristics of the 110-foot submarine chasers as finally adopted are as follows:

Length, 110 feet.
Beam, 15 feet 4¾ inches.
Draft aft, 6 feet 3 inches for displacement of 75 tons.
Mean draft, 5 feet 3 inches for displacement of 75 tons.
Freeboard forward, 9 feet 9 inches.
Freeboard aft, 4 feet 1 inch.

Propelling machinery:

Three 6-cylinder standard marine gas engines.
Bore, 10 inches; stroke, 11 inches.
B. H. P., 220; R. P. M., 460; weight, 6300 pounds each.
One 2-cylinder 4½-inch x 5½-inch Auxiliary engine driving a 4½-K. W. dynamo and pumps.
Speed at displacement of 66.5 tons:
One engine at 370 R. P. M., 9.4 knots.
Two engines at 460 R. P. M., 14.25 knots.
Three engines at 460 R. P. M., 16.85 knots.
Cruising radius at 10 knots, 900 miles.
Fuel capacity, 2400 gallons of gasoline.
Fresh water capacity, 945 gallons.

Armament:

One 3-inch 23-caliber gun.
Two machine-guns.
One depth charge projector.

Complement:

Two officers.
Twenty-four men.

Contracts were placed for the construction of 355 chasers toward the end of March, 1917, shortly before the United States declared war on Germany. This number included 135 ordered

to be built at navy yards. The program called for delivery of all of the boats by January 1, 1918. While a number of the boats were not completed until after this date, due principally to the difficulties encountered by the Standard Motor Construction Company in making engine deliveries, the program was completed so close to schedule time that it is believed to be unique in this respect as compared to other war programs of equal magnitude.

The construction of so large a number of boats in less than a year was possible only by the closest co-operation between the bureaus of the Navy Department, the builders, and the inspectors —the last mentioned in many cases having to assume the functions of management at the building yards in order to expedite the work.

There is always an element of chance in venturing on a very large duplication program without building a pattern boat to correct omissions and conflicts in the plans. It is impossible to reduce to drawings in advance of construction every detail of a ship design of an entirely original type, especially when time is the essence of the undertaking. In the case of the 110-foot chasers the risk had to be taken of proceeding at full construction capacity without awaiting the completion of one boat. However, the next best substitute for building a complete pattern boat was adopted by pushing one of the chasers at the New York Navy Yard ahead of the rest.

The New York Navy Yard was given an order to proceed with the construction of 60 chasers on March 19, 1917. The first boat was launched on May 7, 1917. On May 9, 1917, the gun firing trials were held on this boat—50 days after the order to proceed with the work was received by the yard. This was a remarkable piece of work, as the yard had to purchase practically all of the materials for the job, many plans had to be made and details of construction had to be perfected.

The design of the gun foundations was of particular importance, as it was necessary on the one hand to avoid excessive weight and on the other hand to provide an adequate structure for properly distributing the recoil stresses to the hull of the boat. There was no past experience to draw on, as the installation of a 3-inch gun on a wooden boat of light construction was a new departure. The first boat was so rapidly completed at the New York yard that no delays in the program resulted from

postponing the final design of the gun foundations until after the gun trials on this boat.

In the summer and fall of 1917, extensive experiments were conducted by the Bureau of Steam Engineering on listening devices for detecting the presence of submarines. The 110-foot chasers were largely used for making these experiments. The boats as now equipped have two types of listening apparatus, although one is in a measure a development of the other. Eventually it is probable that a single device will be perfected which will accomplish what the two separate devices now accomplish. One is the K-tube which is lowered over the side or trailed astern. A submarine under way can be heard, under favorable conditions, at a distance of about 30 miles with this type. In the K-tube electrical and acoustical principles are combined to produce a wonderfully ingenious instrument of remarkable sensitiveness.

The second is the SC-tube, or in the case of some of the boats, the MB-tube. These latter devices are purely acoustical in their functioning principle. The SC- (or MB-) tubes are fitted in duplicate through the bottom of the boat and are raised and lowered through permanent hull castings. The reason for the two types of apparatus is that each has its special use. The K-tube is at its best when trailing over the stern or alongside with the boat drifting. In its present state of development it cannot be installed as a permanent fitting to the hull. It must also be taken in when the boat is under way. It is the instrument for detecting the approach of a distant submarine. While the SC- and MB-tubes are good only for about three miles, they have the great advantage that they are fitted to the hull. These tubes can be placed in service instantly the boat stops and no delay is involved in housing them on getting under way. The story of the development of listening devices is one of the most interesting pages of the history of the war. While some of the best scientists and engineers in the country were engaged on this work and accomplished remarkable results, it is probable that the surface of this field of investigation has only just been scratched.

In order to provide favorable conditions for hearing distant propeller sounds, it is necessary that local sounds on the listening vessel be suppressed to the maximum. During the early tests on destroyers and other steam-driven craft, it appeared that the difficulty of stopping all local noises, such as pumps, generators,

blowers, etc., would set a limit on the efficiency of listening devices. In the case of the 110-foot submarine chasers none of these handicaps exist. The engines and auxiliary set can be stopped in a moment, the lighting system and blowers under these conditions taking their power from the storage battery. This leaves no running machinery except the blowers. These can be stopped for such periods of time as necessary without discomfort. A mounting was eventually developed for the forward blower which insulates the sound from the listening device so that it can be kept running continuously.

From several points of view, the 110-foot submarine chasers are the ideal type of craft for hunting submarines. As mentioned above, the suppression of local sounds offers no difficulties, thus permitting the use of the listening devices at maximum efficiency. The boats can be stopped from full speed ahead in less than two boat lengths. The turning circle is very small and the maneuvering facilities are therefore ideal for this work. In this connection it may be mentioned that the destroyers were often considerably handicapped in making depth bomb attacks on submarines because of their large turning circles.

The tactics used by the 110-foot chasers in hunting submarines were as follows: Three chasers worked together, running in line abreast at about 400-yard intervals. On signal, all of the vessels stop, lower the listening tubes and take a bearing of the submarine sound. The two wing boats transmit the bearings by wireless telephone to the center boat, which is the flag boat, the center boat having in the meantime also taken a bearing of the submarine. A three-arm plotting board is used for plotting the position of the sound, this being at the intersection of the three bearings. The boats then proceed at a directed speed to the position of the submarine as plotted. On arrival at this position, the boats stop, lower their tubes, and take another bearing. This procedure is continued until the chasers reach a position within a few hundred yards of the submarine. By this time the group commander can make a fairly close estimate of the speed and course of the submarine. The depth bomb attack is begun by dropping a pattern which will include all of the area in which the submarine is likely to be at the time—the formation of the boats being shifted accordingly. After each pattern, the chasers again listen in to determine whether the submarine is still under way. If the water

is shallow the submarine will probably lie motionless on the bottom. A trailing device is in use on the chasers which is supposed to indicate when it is dragged across the submarine.

Chaser tactics in hunting submarines would no doubt have been developed to a high degree of efficiency had the war continued. To meet the contingency of a submarine coming to the surface to attack by gunfire instead of making an attempt to escape under water, the plan was being worked on at one base of using a destroyer as a killer to accompany a certain number of chasers, acting as the hunters only, with the idea that should the submarine come to the surface, the destroyer's gun power would be available to deal with the situation.

As the need for patrol craft was particularly urgent on the coast of France, the first 50 vessels to be completed were turned over to the French Government. These boats crossed the Atlantic in winter weather and to a considerable extent under their own power. They were towed part of the way, as their fuel capacity was not sufficient to carry them across. Later on, special arrangements were made on several tankers for fueling the chasers on the way across. This proved to be more satisfactory than towing.

One of the chasers in the first group taken over by the French became separated from the convoy, due to an engine breakdown. After repairs had been made, the chaser failed to catch up with the convoy and had further machinery trouble. The supply of lubricating oil then ran out. Olive oil and butter were used as a substitute, so far as available. Finally, the gasoline supply became exhausted with the chaser still hundreds of miles from port. The commanding officer then made a sail from blankets, sheets, and pieces of canvas and finally reached port after being on his own for almost a month. After this, all of the chasers were equipped with a sail.

Just how the chasers managed to stow all of the gear which was added from time to time is a mystery. However, the problem of stowage room was of smaller concern to the designers than the constantly increasing weight of the boats. Nothing grows so fast as the displacement of a small boat. The designed normal load displacement of the chasers was 54 tons. This has grown to approximately 84 tons for full load condition. The increase in displacement started with the change from a 6-pounder to a 3-inch gun, then the addition of an extra 3-inch gun, the change to the

depth bomb armament, the addition of listening apparatus, direction indicators, towing gear, etc., and the end is not yet. No doubt most of the added weight is useful and increases the efficiency of the boats even at the expense of speed which has necessarily suffered.

It requires some stretch of the imagination, however, to justify some of the weights added unofficially by the personnel. One commanding officer took great pride in pointing out a large hot water heater which he had rigged in the bathroom—it must have weighed more than a hundred pounds and consumed a shocking lot of K. W.'s from the already overloaded storage battery. If this enthusiast had known how grudgingly weight was allowed for such important features as an added eighth of an inch of thickness for the planking, how prayerfully the question was considered of reducing the rudder stock from 5 inches to 4½ inches to save a few hundred pounds, when there would have been so much more comfort to the designer in the 5-inch stock, he would have hesitated to point with pride to his hot water heater.

The first submarine chasers to reach France gave such good satisfaction that 50 additional boats were ordered in January, 1918, and in March, 1918, 42 more were ordered for our navy.

Chasers were built by the contractors and navy yards tabulated on next page.

THE EAGLE CLASS

Toward the latter part of 1917, further consideration was given to the possibility of building steel boats of smaller size than destroyers, but having a greater cruising radius than the 110-foot submarine chasers. The greatest disability of the submarine chasers was their short cruising radius and their large consumption of gasoline, which was difficult to obtain in the war zone. The 110-foot chasers have a cruising radius of about 900 miles at a speed of 10 knots under full load displacement of 84 tons. This radius is perhaps sufficient for off-shore work in hunting submarines, but is not enough to permit their use as escort vessels to any great distance.

In considering the possibilities of building steel patrol boats, it was again necessary to eliminate the established shipbuilding facilities as possible sources of construction. The interest of the Ford Motor Company was awakened in this project and after

Name	Address	Boats and numbers: First contract	Second contract (for French government)	Third contract
New Orleans Naval Station.	New Orleans, La..	1–4	.....	443–444
		114–115	.....	.....
New York Navy Yard.....	Brooklyn, N. Y....	5–64	.....	.....
Mathis Yacht Bldg. Co.....	Camden, N. J.....	65–74	381–385	426–430
		209–213	.....	.....
Hiltebrant D. D. Co.....	Kingston, N. Y....	75–89	371–375	421–425
Elco Co.....	Bayonne, N. J.....	90–105	361–364	.....
Charleston Navy Yard.....	Charleston, S. C...	106–113	.....	.....
Norfolk Navy Yard.....	Norfolk, Va.....	116–136	.....	.....
Hodgdon Bros.....	E. Boothbay, Me...	137–138	.....	.....
Hartman-Greiling Co.....	Green Bay, Wis...	140–141	.....	.....
Rocky River D. D. Co.....	Rocky River, Ohio.	142–143	403–406	437–438
Vinyard S. B. Co.....	Milford, Del.....	144–146	.....	.....
L. E. Fry & Co. (E. J. Wright)	Clayton, N. Y.....	147–148	.....	.....
		337–338	.....	.....
Dubuque Boat & Boiler Wks.	Dubuque, Iowa.....	149–150	.....	.....
Gibbs Gas Engine Co.....	Jacksonville Fla...	151–155	365–370	.....
		204–208	.....	.....
F. M. Blount.....	Pensacola, Fla.....	156–159	.....	.....
Howard E. Wheeler.....	Brooklyn, N. Y....	160–168	.....	339–441
Matthews Boat Co.....	Port Clinton, Ohio.	169–178	386–392	431–433
International S. B. & Marine Eng. Co.....	Upper Nyack, N. Y.	179–188	.....	.....
General S. B. & Aero Co...	Washington, D. C..	189–203	.....	.....
Alexander McDonald.....	Mariner's Harbor, L. I., N. Y.....	214–217	.....	434–436
Newcomb Life Boat Co....	Hampton, Va.....	218–222	.....	.....
N. Y. Yacht, Launch & Engine Co.....	Morris Heights, N. Y.....	223–242	393–402	.....
Eastern Shipyard Co.....	Greenport, N. Y...	243–247	.....	.....
Camden Anchor-Rockland Machine Co.....	Camden, Me.....	251–252	.....	407–408
Geo. Lawley & Son.....	Neponset, Mass....	253–272	.....	.....
Mare Island Navy Yard....	Mare Island, Cal...	273–287	.....	.....
Puget Sound Navy Yard...	Bremerton, Wash..	288–312	.....	.....
Robert Jacob.....	City Island, N. Y...	313–317	.....	.....
Luders Marine Const. Co...	Stamford, Conn....	318–322	.....	.....
Kyle & Purdy.....	City Island, N. Y...	323–327	376–380	.....
Great Lakes B. B. Corp.....	Milwaukee, Wis...	328–329	.....	419–420
Burger Boat Co.....	Manitowoc, Wis...	330	.....	.....
Smith & Williams Co.....	Salisbury, Md.....	331–332	.....	.....
Barrett S. B. Co.....	Mobile, Ala.....	333–336	.....	.....
American Car & Found. Co.	Wilmington, Del...	339–346	.....	.....
College Point Boat Corp....	College Point, N. Y.	347–356	357–360	413–418
Clayton S. & B. Bldg. Co....	Clayton, N. Y.....	.....	.....	411–412
Chance Marine Const. Co...	Annapolis, Md.....	248–250	409	.....

a general estimate of the situation had been made, a design was prepared by the Bureau of Construction and Repair of what are now called the eagle class of boats. The construction of the boat was simplified in every possible way, having in mind that the Ford Motor Company were not shipbuilders and needed every consideration in the way of simplified construction to facilitate the work.

The boats have the following general characteristics:

Length, 200 feet.
Beam, 25 feet 6 inches.
Draft, 7 feet 3 inches.
Normal load displacement, 500 tons.
Single screw, turbine driven.
Normal shaft H. P., 2000.
Overload shaft H. P., 2500.
Speed, 18.3 knots.
Cruising radius, 3500 miles.
Armament: Two 4-inch 50-caliber.
One 3-inch 50-caliber anti-aircraft.
One depth bomb projector.

The Ford Motor Company was directed in January, 1918, to proceed with the construction of 100 of these boats, to which number 12 more were added later on for the Italian Government. Since the signing of the armistice this number has been reduced to 60. A shipbuilding plant was erected at River Rouge on the outskirts of Detroit for fabricating and assembling the hulls. The machinery and fittings were largely built at the Ford Motor Company's plant, Highland Park, Detroit. The contract called for the delivery of 100 boats by December 1, 1918. While only seven of the boats left the plant before the close of navigation, the performance of the Ford Motor Company in completing even this number is creditable when one considers that this company had had no previous experience in shipbuilding and made practically no call on the shipbuilding industry for assistance. This latter policy is considered by some to have been a mistake, as the work could have been very materially accelerated had the contractor employed a sufficient number of men skilled in the various shipbuilding trades to act as instructors for his men. Great credit is due Mr. Charles C. West, the superintending constructor for the navy, and to Commander Carlos Bean, U. S. N., inspector

of machinery, for the assistance which they rendered the Ford Motor Company in this project.

The Ford Motor Company attempted many novel methods of shipbuilding, some of which proved successful, such as building the boats on trucks which were moved along as the construction progressed and which finally transferred the hulls to a hydraulic dock which lowered them into the water. One of the innovations was the building of a complete pattern ship for the purpose of perfecting the working plans and for making the templates, forms and patterns which were used to duplicate the various parts of the 112 vessels.

The construction of this pattern ship under the direction of the superintending constructor for the navy, Mr. West, who is a skilful and experienced shipbuilder, made it possible for a company with no previous shipbuilding experience to build successfully seven ships of 500 tons displacement in nine months.

It is not generally realized that the eagle boats are vessels of considerable size. They are much larger than the early torpedo-boats and are in fact larger than the destroyers built in 1902 and 1903. The destroyer *McDonough*, commissioned in 1903, had a displacement of only 400 tons.

The eagle boats are designed to have a cruising radius of 3500 miles. On trial, the first boat made a speed of 18.3 knots. These boats will prove a very valuable addition to the navy, as they are adapted to the kind of duty performed by gunboats. This is more than can be said of the 110-foot chasers. While these latter vessels were a successful temporary expedient, they are a heavy liability as a permanent addition to the navy, because of the rapid deterioration of any vessel built of wood.

The question of what types and numbers of vessels to build for the navy is largely a matter of cost. In the case of capital ships, cost must be relegated to a secondary place if the navy is to keep step with the most recent construction of other powers, as such ships are usually built as an answer to the designs of other navies with a constant endeavor to improve on the previous design.

In the case of a definite problem, such as presented itself in this war, namely, combating submarines, it is interesting to speculate whether the 110-foot submarine chasers, the 200-foot eagle boats, or the destroyers, were the best investment for the particu-

lar problem which had to be solved. The following is a comparison of the approximate cost in 1918, and the man power required to operate these three types of vessels:

	110-foot chasers	boats	Destroyers
Approximate cost, including armament	$80,000	$486,000	$1,800,000
Ratio of cost	1	6	22.5
Complement, officers and men	26	72	133
Crew ratio	1	2.8	5.1

Assuming that a periscope can be seen as far from the bridge of a chaser or an eagle boat as from the bridge of a destroyer, and this is believed to be a correct assumption, the ratio of sea area covered by the three types of vessels is about 1:1.2 and 2.3, based on the speed of each type. Applying this ratio to the cost it will be noted that per dollar of investment a 110-foot submarine chaser covers approximately 10 times as much area as a destroyer and that an eagle boat covers about twice as much area as a destroyer. The man power for operation is also in favor of the smaller vessels.

Any discussion of the relative value of destroyers versus smaller ships, such as the 110-foot chasers or eagle boats for escort and patrol duty, may perhaps now be considered academic, because the submarine will probably never again play the rôle that it did in the Great War. As units of a fleet in action it is doubtful whether any surface craft smaller than a destroyer is a good investment. However, off-shore patrols will always have to be maintained in case of war with a sea power.

Our experience with the 110-foot chasers has demonstrated that patrol vessels capable of going to sea and staying at sea in any kind of weather can be provided at a cost far below the price of destroyers, both as to original cost and as to man power required for operation. It has also been demonstrated that it is not possible to augment the destroyer force quickly, whereas it is possible to build large numbers of smaller craft suitable for patrol work in a short space of time. One year from the declaration of war three hundred and fifty 110-foot chasers had been added to the navy list, whereas only seven new destroyers had been commissioned.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON THE RADIO COMPASS

By Ensign Bowden Washington, U. S. N. R. F.

The radio compass (radio pelorus would perhaps be a better name, as it always gives relative bearing, except ashore) is a device for determining the direction of a distant radio transmitter, and, granting that this object is attained, would seem to have considerable value for both navigational and military purposes. The present type of U. S. Navy radio compasses, though a comparatively new device and one which can be subject to tremendous improvement, is, if properly operated, a thoroughly practical piece of apparatus. It has been the writer's experience that, on the ships equipped with the radio compass, generally very little use has been made of it, and, it is believed, that owing to several causes, matters not inherent to the apparatus itself, it has come rather into disfavor. The writer hopes in these few notes to point out what he believes these causes to be and their remedies. From having installed, tested and operated probably 50 radio compasses on battleships, cruisers, destroyers, chasers and ashore it is natural that one should develop considerable interest in the device, and its operation, when in competent hands, has led to the development of faith in its performance as well.

The fundamental principle of operation is exceedingly simple, as is the apparatus itself if looked upon in the proper light. It is known to any one familiar with elementary physics that if a coil of wire is passed edgewise between the poles of an electromagnet, a potential is set up in this coil, and if the circuit in which this coil is inserted is closed a current will flow. This is really the fundamental principle of the dynamo. On the other hand, if the coil is passed between the poles of the magnet in such a position that its plane is the same as that of the magnetic lines of force between the poles, the potential induced will be in opposite directions in opposite sides of the coil and no current will flow. It can be readily seen that the above is true

whether the magnet or the coil is moved; that is, passing the lines of force through the coil or the coil through the lines of force.

The magnetic component of the electromagnetic wave spreads out from the transmitting station in concentric lines of force like ripples on the surface of a still sheet of water into which a stone has been dropped. If a coil of wire is placed with its axis horizontal and the plane of its winding in the direction of a distant transmitter it will "cut" these lines of force as they pass through it, and a current will be induced in the coil. On the other hand, if the plane of the coil is at right angles to direction of the transmitter no current will result. If suitable detecting apparatus is added, as in any radio set, to make these high frequency currents audible, we have a radio compass.

In the navy radio compass a coil of a dozen or so turns is mounted upon a shaft, equipped with a handwheel and scale, in a weatherproof house above the operating room. The shaft is fitted with collector rings and brushes to lead the current to and from the coil, which is connected in series with the secondary of an ordinary radio receiver, the primary of which is not ordinarily connected to anything. As the ability to absorb energy of a coil of this sort is perhaps a thousandth part of that of a ship's antenna, an amplifier is provided which increases the strength of the signal 400 times, thus giving the device a practical range of operation. It is only necessary for the operator to tune for the proper wave-length, rotate the coil until he finds the points (two—180° apart) of minimum signal and read these points on his scale. This places the sending station on a line—our relative bearing may be either of the two readings. For those sufficiently interested, I will attempt to describe how it is possible to discover which of these readings is the desired one.

Provided, of course, that the distance to the transmitter, power of the transmitter, etc., remains the same, the strength of the signals varies, when the coil is rotated, as the sine of the angle its axis makes with the direction of the transmitter. (Hence the use of the minimum points, as the rate of change of signal strength is much greater, thus making for accuracy.) When this is plotted in polar coordinates a figure eight will result. An ordinary vertical antenna has no directional effect and its polar plot, angle of transmitter against strength of signals, is therefore a circle. If a vertical antenna is connected to the primary of the

radio compass receiver and the coupling is adjusted so that the proper amount of energy is transferred to the detector circuit, we will have a circle superimposed upon a figure eight. As the two loops of the figure eight occur with a reversal of the position of the coil, the current of one may be regarded as plus, the other minus, with respect to the antenna circle. Thus one subtracts from the circle, the other adds, producing a "cardioid," or heart-shaped curve, having one minimum which is read. This reading is not as accurate as when the coil alone is used, and is only to determine which of the two coil readings is the desired one.

It is necessary that a correction (or variation) curve be plotted at the most used wave-lengths. Variations appear to be largely due to two causes: The first, and most objectionable of these, is due to the fact that masts, wire rigging, etc., are set into oscillation by the distant transmitter and some of this energy will be re-radiated, and on being picked up by the compass will give a reading which is the resultant of this energy and the energy from the transmitter. The second source of variation is the tendency of the wave to follow the ship's hull. This effect is pretty consistent, and necessitates the application of a + correction from bow to starboard beam, − to astern, + to port beam and − from port beam to dead ahead. The variation is usually maximum at relative bearings 45°, 135°, 225° and 315°, and zero at 0°, 90°, 180° and 270°. These variations will sometimes be as much as 30°, particularly on the shorter waves, but are consistent within 1° or 2°. The accuracy of the device depends largely on the strength of the signals; *i. e.*, the distance and power of the transmitter. In general, it may be stated that a cut should be obtainable on a battleship or shore station at a distance of 100 miles within ±5°. The inherent inaccuracy of readings of the radio compass, due to the fact that absolute minima are not obtainable with the present U. S. Navy type, is probably ±2°. This latter varies considerably with local conditions. Re-radiation from stays, etc., is always somewhat out of phase with the direct radiation when it arrives at the compass coil, and this has a tendency to dull the minima.

The older ships with military masts and considerable wire rigging are the hardest on which to obtain results. The *Montana's* compass was found to be absolutely useless at a wave-length of 300 meters, due probably to a backstay from the main truck to the taffrail, but was fair on 600 meters (could be read

within 3° or 4°). A great deal of this sort of thing could be eliminated by inserting insulators in all wire rigging over, say, 50 feet in length.

Little or no trouble of this sort is experienced on destroyers, the rigging being comparatively short, and cage masts seem to be less objectionable than would at first be supposed. An idea of the degree of accuracy to be obtained on destroyers may be obtained from the following:

The writer, aboard one of the new boats, when about 10 miles off Provincetown, took bearings on the Boston Radio Station and on New York Navy Yard. The former was within 1°, the error of the latter was found to be 4°.

Not long ago, the writer went aboard 17 destroyers lately returned from European waters, all equipped with radio compasses, and interviewed the commanding officers, radio officers, and electricians in charge. Most of these ships had had their apparatus installed on the other side. It was learned that only three had made any real use of the radio compass. These three ships will be referred to again as an example of what can be done. There appeared to be several reasons for this poor showing. In a great many cases the apparatus was never tried until it was actually needed. The men had therefore no practice in its use, and it failed. Also, on these same ships it had not been used for long intervals and therefore was in poor condition when needed. (The radio compass requires no more, no less, care or intelligence than the ordinary receiving set.)

On one ship the compass room had been used as a potato locker.

In general, the operators had had little or no instruction in its theory or use, and seemed to believe it to be complicated and difficult to understand; when, as a matter of fact, any second-class radio electrician who deserves his rating and is therefore fairly familiar with ordinary radio receivers should be able to master both theory and practice in perhaps two hours.

Another thing which made against the efficient working of the device was the addition by the various radio electricians of other apparatus in an effort to "copy press," etc.

It was evident also in some cases that the chief electrician (radio) had belittled its value in an effort to get out of an extra watch and an extra station to look after.

It is natural that no confidence should be felt in the apparatus until it has been demonstrated to work reliably.

It is believed, however, that if the electrician on watch is required to take several bearings during each watch on stations of known position and report these bearings to the bridge to be checked it will not only afford excellent practice for the operator, but will eventually demonstrate to the navigator the value of the apparatus. If good bearings are not obtained, and the apparatus has been properly installed in the first place, it can be attributed to extreme stupidity, or lack of trying, on the part of the operator. One instance can be mentioned as an indication of this fact. After completion of a shore radio compass station, two of the permanent crew arrived and were instructed for perhaps half an hour by the writer. Upon returning about three hours later they were found to have taken probably 30 cuts on land stations along the coast, most of which checked up within 3° or 4°, the worst error being in the neighborhood of 8°.

On a coast station at Gloucester, Mass., cuts have been repeatedly made on stations as far as Cape Race and Halifax, Bermuda and Key West which were consistently accurate within 6° or 8°, and stations within 100 to 150 miles would repeat to a degree.

It may not be out of place to mention now a few of the uses to which the radio compass was put by the ships that really used it. Two enemy submarines were located. In both cases the destroyers were with convoy, and could not attack, but the fixes obtained were afterwards verified by the British. One destroyer made port three times in fog by means of her radio compass. A torpedoed transport was found at a distance of 27 miles. Contact with other warships was established frequently. Convoys were picked up when off their rendezvous. One ship, as a check, took cuts on land stations when 150 miles out from Brest. These came within three miles of their noon sight. Too much reduction in speed from the original engine calibration was made when allowing for listening-gear drag, and when returning from abroad Nantucket Shoals Lightship was found to be abreast instead of 65 miles ahead as expected from dead reckoning.

It must be remembered that all these ships had identical apparatus, were in many cases identical ships, and had average enlisted radiomen. The only outstanding difference between the three ships whose performances are recorded above and the remaining 14 was that in each of these three ships one officer, at

least, believed that the radio compass would work and insisted that it should work.

One cannot but feel that the radio compass, as an aid to navigation, will develop into something of considerable value. Stations are now under construction in the vicinity of several important harbors along the Atlantic coasts. These should be of some service in bringing ships in which have been forced to make a long passage with no opportunity to check their dead reckoning, and, if properly operated, would, even in the event of a ship having been able to get plenty of sights, be an additional safeguard. The best mode of operation would seem to be to have these stations take simultaneous bearings when requested and transmit these bearings by land wire to a central radio transmitting station, equipped with a chart having a compass-rose at each radio compass station and a rule pivoted at each. Four compass stations for a port of the importance of New York or Boston would seem desirable. The central station could then almost instantly determine the ship's position and send it to her by radio. It has been suggested that each compass station be equipped with a transmitter, but this plan seems to have some objectionable features; namely, the cuts cannot be checked against each other by an experienced radioman who knows from experience their relative values. Each station will have to send its reading separately, thereby creating more radio interference. I believe it to be somewhat questionable if merchant skippers on small ships will very frequently go to the trouble of getting a fix, but would probably be delighted to use it if given them.

I think it may be confidently stated that even in the present state of the art, shore radio compass stations can be built, if sufficient care is taken, which will give cuts within $\frac{1}{2}°$ to a ship equipped with a 5-kilowatt transmitter at a distance of 400 miles.

In summary, it might be said that experience has led me to believe that the radio compass in its present state is a practical and valuable device and, if no results are obtained, it rests entirely with the personnel concerned, directly or indirectly.

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ELECTRIC CHLORINE INDICATOR

By Lieut. Commander P. V. H. Weems, U. S. Navy

The navy standard water testing outfit has been indispensable, yet if an electric indicator could be sufficiently developed to do the work of the former, there would be considerable saving in: (a) Chemicals; and (b) the time necessary for making the tests. There are now on the market accurate and elaborate water testers, but none seem to be practical for use aboard ship.

To obtain accurate data for developing a suitable electric indicator for the chlorine in water, it was necessary to run several tests. These tests gave the most promising results, as shown in Figs. 2 and 3. The complete apparatus is shown in Fig. 1. In a glass tube, 1½ inches in diameter, were fitted terminals of ⅛-inch brass wire, 1 inch apart, and 8 inches long. Two 60-watt Mazda lights connected in parallel were used as the pilot lights in the actual tests, but one light of the proper size would be preferable.

Water containing varying amounts of chlorine was poured into the tube till the pilot lights showed a faint glow, then the height of the water in tube and the ammeter readings were taken. These readings were taken only as a check, for the amperage for each test was approximately .12 amperes. With the height of the water in the tube, or with what is the same thing, with the immersion of the terminals as the ordinates, and with the number of grains of chlorine per gallon as the abscissæ, a curve was plotted. Since the conductivity of water varies with different temperatures, tests were made with the water at different temperatures. These results are shown in Fig. 3. Curves were also plotted (Fig. 2) with the immersion of the terminals as ordinates and with the temperature of the water as abscissæ. Water containing different amounts of chlorine was tested, giving the different curves, as shown in Fig. 2. This curve gives

the better results when the temperature of the water and immersion of the terminals are known and it is desired to measure the chlorinity.

To obtain the amount of chlorine in water where it is unknown, fill the tube till the pilot lights glow faintly, read the amount the

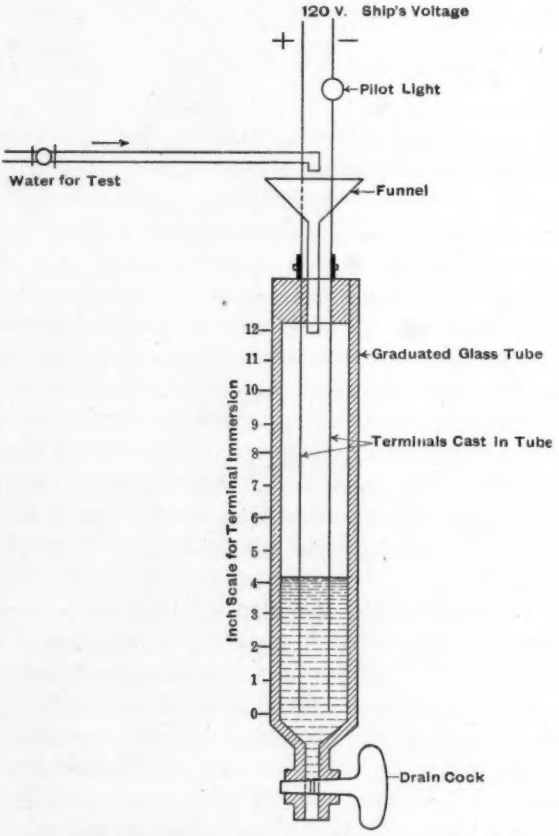
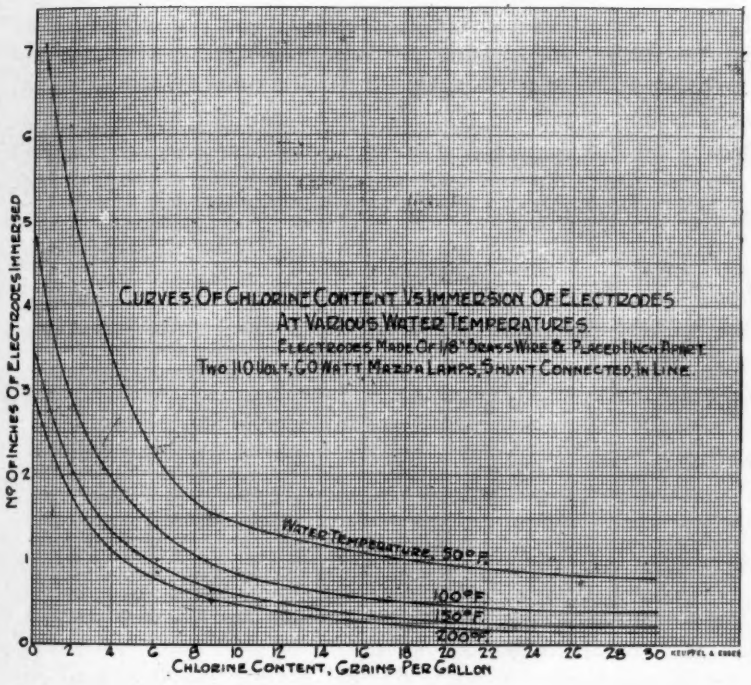
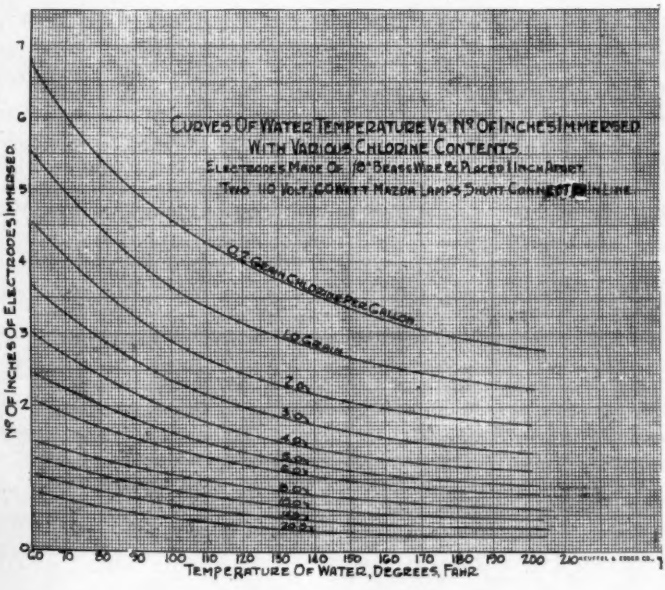


FIG. 1.—Diagram of Electric Chlorine Indicator.

terminals are submerged, then, knowing the temperature of the water, pick off on the curves (Fig. 2) the number of grains of chlorine per gallon.

The electric chlorine indicator does not, of course, discriminate between one kind of substance and another; analysis alone can


CURVES OF CHLORINE CONTENT VS IMMERSION OF ELECTRODES
AT VARIOUS WATER TEMPERATURES
ELECTRODES MADE OF 1/8" BRASS WIRE & PLACED 1 INCH APART
TWO 110 VOLT, 60 WATT MAZDA LAMPS, SHUNT CONNECTED, IN LINE
Nº OF INCHES OF ELECTRODES IMMERSED
WATER TEMPERATURE, 50°F.
100°F
150°F
200°F
CHLORINE CONTENT, GRAINS PER GALLON
KEUFFEL & ESSER


CURVES OF WATER TEMPERATURE VS Nº OF INCHES IMMERSED
WITH VARIOUS CHLORINE CONTENTS
ELECTRODES MADE OF 1/8" BRASS WIRE & PLACED 1 INCH APART
TWO 110 VOLT, 60 WATT MAZDA LAMPS, SHUNT CONNECTED IN LINE
Nº OF INCHES OF ELECTRODES IMMERSED
0.2 GRAIN CHLORINE PER GALLON
TEMPERATURE OF WATER, DEGREES FAHR.

do that. But in most instances in which water testing is carried out for marine engineering purposes, the substance present in the water is chlorine. Such tests are not made for purposes of analysis, but usually to find out the amount of chlorine that is present in the water; and in this case the electric chlorine indicator gives the required information with a rapidity and simplicity unapproached by any chemical test.

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THE UNITED STATES NAVAL PROVING GROUNDS

By Lieut. Commander C. L. Lothrop, Jr., U. S. Navy

Purpose.—Many of the younger officers of the service are unfamiliar with either theory or practice at the Naval Proving Grounds, and this paper is presented with the intention of reminding them of the vital necessity of the station's existence. It is also desired to bring up to date existing publications on the subject. The larger portion of navy ordnance must pass through the proving grounds before issue to the service, and upon their efficiency depends directly the efficiency of most of the material supplied by the Bureau of Ordnance.

To visit the proving grounds for at least a casual inspection should be part of the education of every officer; but a natural confusion as to what is going on is almost inevitable unless a clear conception is borne in mind of the purpose of the station. It may be likened to the testing laboratory of a large manufacturing plant, in which is tested, *in accordance with specifications,* all the material which goes into the finished product.

Similarly, all guns, mounts, projectiles, powder, fuses, ammution details and armor are tested, *in accordance with specifications,* at the proving grounds. Such specifications are laid down from time to time by the Bureau of Ordnance, and are compiled to include the best and latest ideas of the service and of ordnance engineers of this and foreign countries. If the material passes the prescribed tests satisfactorily, it is accepted; if it fails on any of the prescribed tests, it is rejected.

The desirability is thus indicated of having officers, both afloat and ashore, communicate with the bureau in regard to ordnance material which does not function perfectly, in order that such defects may be corrected in future types. This statement may seem too axiomatic to older officers of the service, but it cannot be too strongly impressed upon the younger members, whose tendency is to "make it work" and then forget that others may be experiencing similar troubles.

New devices are also tested at the proving grounds, and the increasing growth of the experimental department shows clearly the opportunity and the urgent need for research work in ordnance and gunnery. New ideas and developments of material in the service should, in a similar manner to reports of defects, be submitted to the bureau for consideration.

Location and Size.—The United States Naval Proving Grounds consist of the upper station, situated at Indian Head, comprising a tract of land of 409 acres on the left bank of the Potomac River, about 25½ miles below Washington, and the lower station, of 1365 acres on the right bank of the Potomac, 41 miles below Indian Head. The former has a water range of 18,000 yards, and the latter 100,000 yards. The entire reservation at Indian Head includes about 882 acres, of which the larger portion is occupied by the United States Naval Powder Factory. The proving grounds are entirely separate in administration from the Naval Gun Factory at Washington, D. C., coming directly under the Bureau of Ordnance.

Data Observed.—The bread and meat of proof work are velocity and pressure. Other data are recorded, but a clear understanding of the methods of obtaining these two vital necessities is essential.

Measurements of Velocities and Pressures.—Velocities are obtained usually from the Boulengé chronographs, which measure the time interval between the successive cuttings, by the projectile, of screens composed of copper wire. The first screen is placed about 80 feet in front of the muzzle, and the second 50 meters further. Separate electric circuits pass through the two screens, and the interval between breaking the circuits of the first and second screens supplies a measure of time for the chronographs. This, taken in connection with the space between screens, gives the projectile's velocity at a point midway between. The velocity is reduced to muzzle velocity at the physical laboratory, located about 400 yards from the firing battery, and is reported to the officer conducting the proof.

Shells recovered sometimes have the marks of screen wires graven on the nose by their rapid passage through. Two marks are usually cut, forming an **X**, of which one angle is the measure of rotation between screens.

Pressures.—Pressures are obtained by the crusher gage (see Fig. 1) from the comparison of copper discs calipered before

and after firing. At least three gages are used, but where special accuracy is desired, six or nine are used, making due allowance for consequent reduction of chamber volume. The gages are placed loose before firing in the rear of the chamber of a B. L. R. or the base of the cartridge case of a R. F. gun. The copper discs are made of uniform metal from which sample discs have been calibrated. For anticipated pressures above nine tons, discs having had an initial pressure of nine tons are used. For pressures below nine tons, unpressed discs are used, except when,

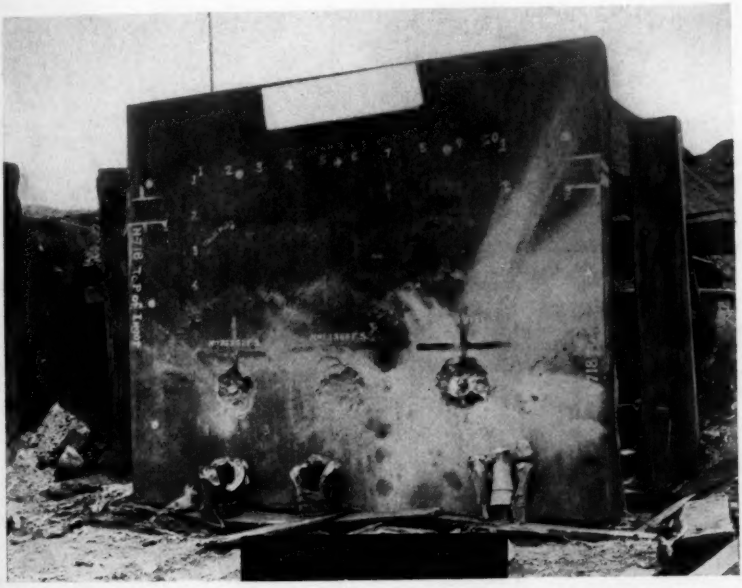

FIG. 1.—Successful Armor Plate After Test. Note Timber Structure and Sand Butt.

in experimental work, extremely low pressures are expected, when lead discs are used.

Types of Proofs.—Tests may be divided into the following:

1. Guns and breech mechanisms.
2. Mounts.
3. Powder.
4. Projectiles.
5. Fuses and tracers.
6. Armor.
7. Explosives.

8. Cartridge cases.
9. Primers.
10. Bombs.
11. Special work.
12. Experimental work.

Proof of Guns.—In accordance with specifications, every gun and breech mechanism must be tested with an overload pressure one and one-quarter times that which it will ever thereafter experience in service. Assurance is thus given that the gun will not

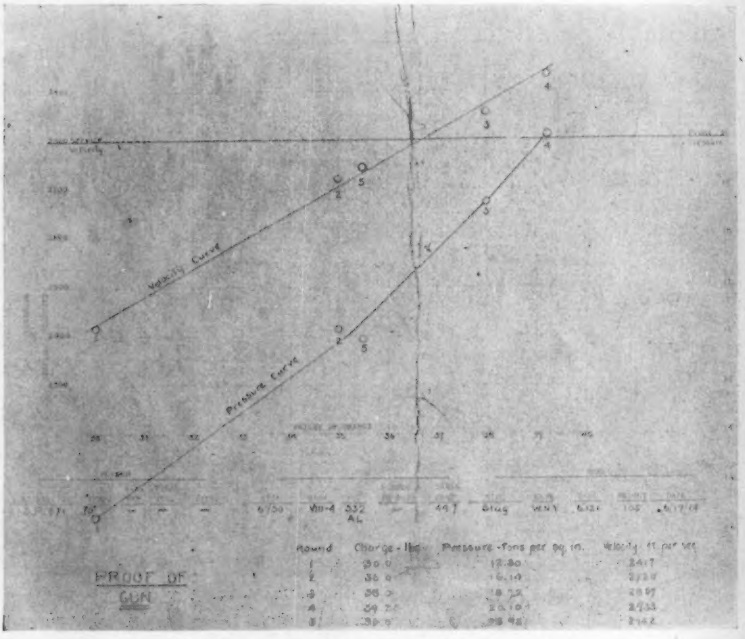

FIG. 2.—Plotting of Rounds Fired During Proof of Gun.

"blow up" on board ship. If a gun is weak, it is better to have it blow up at the proving grounds, where everyone is under shelter. As pressure is a function of the weight of charge, proof pressure is obtained by firing a charge heavier than the service charge.

When guns are completed, they are sent to the proving grounds, having been prepared in all respects for firing. By means of locomotive cranes for medium and minor calibers (see Fig. 2), and gantry cranes for major calibers (see Fig. 3), they are transported to the firing battery, where the mounts, or girders, are clamped to slotted gun circles. The gun, breech mechanism, fir-

ing mechanism and mount are then carefully inspected. Data as shown on firing record are collected and recorded in advance of firing, as regards the characteristics of the gun, mount, projectile, powder, ignition, primer, case, etc.

The officer conducting the proof refers to records, specifications and curves or graphs of previous firings of guns of the same type (see Fig. 4). These curves are plotted with the velocity and pressure as functions of the weight of charge. Having determined the charge to give three-quarters service pressure, he

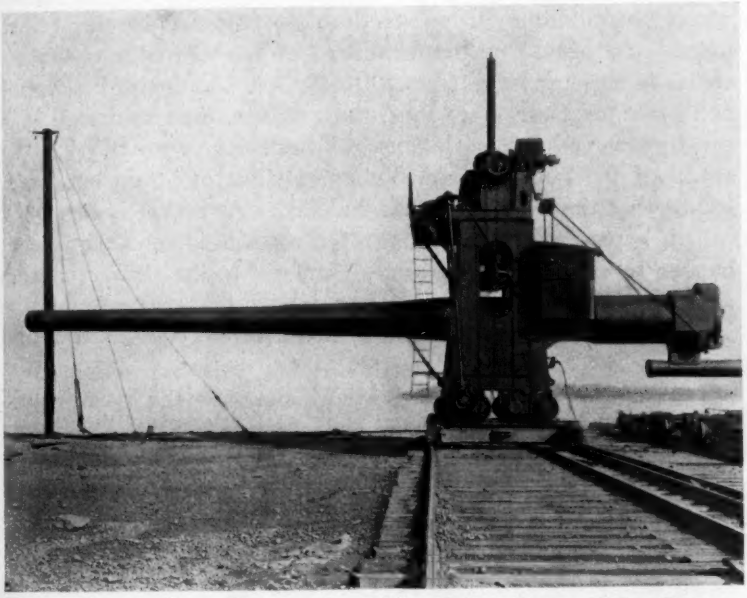

FIG. 3.—Gantry Crane Transporting Major Caliber Gun to Firing Battery.

weighs, checks and, after seeing that all personnel is under shelter, fires the charge.

Plotting, as a function of the weight of charge, the velocity and pressures actually obtained, the proof officer predicts the charge which will give service pressure and velocity. He then successively fires, plots and predicts the charges which will give just below proof pressure, and then proof pressure. In cases where doubt exists, a second proof round is fired. One more service round is then fired to relieve the strains set up by the proof round.

After firing each round, a thorough inspection makes certain that any defects which have developed are discovered. Records

are taken, noting particularly: (1) Cracks in screw-box liner, plug or at muzzle; (2) condition of rifling; (3) crawling of tube or liner, at breech or muzzle; (4) length of recoil and counter recoil; (5) condition of case or gas check; (6) condition of primer; (7) blow-backs; (8) signs of failure of mount; (9) special notes, as directed by the bureau.

When predicting charges above service from the velocity and pressure curves, the proof officer must exercise great care when passing the critical point in density of loading, as pressures will jump excessively when this is reached. Cases have been known where the addition of one-tenth of a pound over the "near proof" charge in a medium caliber gun has caused a 10-ton increase in pressure; *i. e.*, from 18 to 28 tons. As the highest specified proof pressure is 20 tons, the gun was thus subjected to a pressure three-quarters in excess of service pressure. To the credit of the gun, it is noted that no signs of strain appeared, except that the firing lock was wrecked. Attention is especially called, however, to the fact that such an occurrence could not happen by the addition of a small amount to the *service* charge, as the critical point for powders issued to service is always safely higher than around the point of service charge and pressure.

Indicator cards showing the work done by the recoil liquid during recoil and counter recoil are taken with Tabor indicators, and are of much assistance to the gun factory in connection with design and determination of proper functioning. The action of the indicator is similar to one on the cylinder of a reciprocating engine, as the recoil is analogous to the piston stroke, and the recoil liquid pressure to steam pressure.

In special cases, the velocity of recoil may be taken by the chronoscope.

Various guns are given special proofs, *in accordance with the specifications,* which have been developed from the needs of the service. For example, all S. A. guns are fired 10 rounds rapid fire.

After proof, the gun is returned to the Naval Gun Factory, where it is bore-searched and star-gaged, and stamped with "P" and the initials of the inspector of ordnance in charge of the proving grounds.

Proof of Breech Mechanisms.—Breech mechanisms on proved guns are proved with three rounds—service, proof, service. Rapid-fire test of new S. A. breech mechanisms is in addition.

Proof of Mounts.—Mounts are ordinarily proved during proof of gun, but for proof, using a proved gun, three rounds are fired, working up to within a ton of proof pressure.

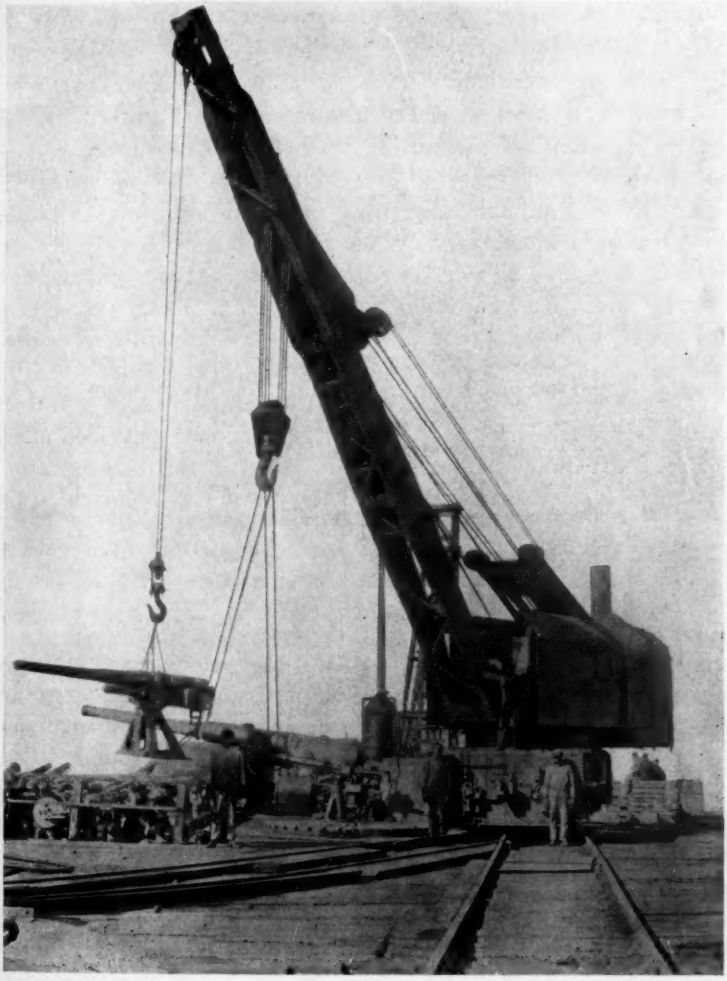

FIG. 4.—Locomotive Crane Transporting Two Guns to Firing Battery.

Proof of Powder.—In accordance with specifications, a sample of each index of smokeless powder is tested, before acceptance by the Bureau of Ordnance, to determine:

1. The weight of charge to give service velocity.

2. The weight of charge to give target practice velocity, in the case of powders for which a reduced velocity is used.

3. The service pressure per square inch.

4. The target practice pressure per square inch.

5. The regularity of a number of rounds, as shown by the mean variation.

Powder is always proved at a uniform temperature of 90° F. (32° C.). This temperature is reached by gentle heating, done in air-tight tanks to avoid loss of volatiles. If the power is for a R. F. gun, the cases used in the proof are also heated to the same temperature. When made up, the charges are exactly as issued to service, as regards ignition, bags, mouth cups, primers, etc. The projectiles used must be of the type to be used in service with the proof powder. Each is carefully measured and weighed before being brought to the firing battery.

The proof of a powder consists of the development of a velocity curve and a pressure curve, in the same manner described under "Proof of Guns." The officer conducting the powder proof examines the "characteristics" of the powder as reported on the accompanying description sheet, *i. e.*,

(a) Web thickness,

(b) Volatiles,

(c) Nitration,

and with these as a guide, consults the velocity and pressure curves of a similar powder. As hundreds of these curves are on file, and allowed variations in powder manufacture are small, approximately the same characteristics can always be found.

If the web of the proof powder is smaller than the reference powder, the former will be quicker; that is, will require a smaller charge for the same velocity. This may be remembered by reducing to absurdity, as, for example, a one-pounder powder is quicker than a 14-inch. If the percentage of volatiles of the proof powder is lower than that of the reference powder, the former will be quicker; *reductio ad absurdum:* a dry powder grain will burn quicker than one soaked in water. If the nitration of the proof powder is higher than that of the reference powder, the former will be quicker. Aid to memory: gun cotton, which has a higher nitration than smokeless powder, is much quicker.

The proof officer can thus make his allowances before firing the low round, which starts the curves at 150 to 200 foot-seconds below service velocity.

Charges are then fired and plotted to run the velocity curve up to 100 foot-seconds above service velocity, unless the accompanying pressures indicate that excessive pressures may be obtained. Four rounds are usually fired, two of which are at or near service velocity.

An examination of the velocity and pressure curves faired through the plotted points gives the information noted in 1, 2, 3 and 4 above; 5 is determined by dividing the total variation of the plotted points from the faired curve by the number of rounds fired.

A small sample enclosed in an air-tight jar is taken during the proof from the proof sample and sent to the chemical laboratory for chemical and physical analysis, as to stability, nitration, volatiles, solubility, web, etc., all of which must be in accordance with the specifications.

After proof a report is forwarded to the Bureau of Ordnance, recommending either acceptance or rejection.

If the powder is accepted, an index number is assigned. This number, together with the manufacturer's lot number and the weight of service charge, is stencilled on the boxes, and the index is forwarded by the manufacturer to a magazine.

Proof of Projectiles.—The types of projectiles purchased for the navy are:

1. Armor-piercing.
2. Common.
3. High capacity.
4. Flat-nose.
5. Shrapnel.
6. Target.

Armor-piercing projectiles are tested in accordance with the specifications under which the contract was let, to ensure their satisfactory operation in service. They are:

1. Fired against plate.
2. Fragmented.
3. Ranged.

For test against plate the inspector at the works selects four projectiles from each lot manufactured. The test simulates the

extreme conditions as to angle of fall, striking velocity and thickness of plate which are anticipated in battle. The face-hardened armor plate used is one of a specified thickness which has previously passed test, and is set up on a heavy oak timber structure in front of a sand butt at a specified angle to normal. The posts of the structure are so set and the impacts so placed that the projectile will pass between the posts from the plate to the sand, without injury to the structure. A tube, shaped like an inverted U, (∩), is placed in front of the plate, and this, with flat cover plates, stops the spread of fragments.

The gun, about 100 yards from the butt, is bore-sighted on a chalk mark on the plate. Screens are placed in the line of fire to measure velocity, which in this case is calculated to give the striking velocity. A pasteboard screen is also used to record whether the flight of the projectile was true.

A charge of powder is chosen from curves of previous firings to give the specified velocity corresponding to the thickness of the plate at the point of impact. After all personnel is well under shelter, the projectile is fired.

Data as to the dimensions of the impact, flaking of the plate, penetration of the projectile, etc., are taken. Fragments of the projectile, if any are in front, are collected and weighed. Unless a second round at the same plate is to be fired at once, the projectile is then dug out of the sand by a bucket crane and after recovery is inspected, checked and photographed.

Two out of four projectiles so fired must be recovered in "effective bursting condition." A full report of the behavior of the test projectiles is forwarded to the bureau.

Four more armor-piercing projectiles are also selected from the first lot of each contract, of which three are ranged and one fragmented.

Projectiles are ranged by firing them at service velocity on a favorable day, from the highest powered gun for which they were designed, in a standard line of fire as laid by a theodolite, at an elevation of 8°. Under these conditions the mean dispersion of several projectiles should be within the limits of the normal dispersion, as indicated by many firings at the Naval Proving Ground. The range should also be as great as that shown by the range tables. Both range and dispersion should also compare favorably with those of station projectiles of uniform characteristics fired at the same time.

Observers at favorable stations on the Potomac River cut in the splashes with theodolites. Their observations are plotted on a plotting board on which are permanently marked the observing stations. The exact position of each splash is thus located and the mean range and dispersion both of test and station projectiles obtained.

During firing the projectiles must not strip their bands, break up or flight erratically.

Projectiles are fragmented in an explosion chamber by exploding electrically a service charge of explosive in the shell cavity. The resulting fragments must be satisfactory in number, size and shape, in order that the maximum damage may be done when bursting on board an enemy vessel.

Common projectiles are tested by ranging and fragmenting a specified number of projectiles per contract, as described for armor-piercing projectiles. Plate test is against special treatment steel plate of a thickness and at a velocity laid down in the specifications for the contract. Projectiles are recovered from the sand butt behind the plate by a bucket crane.

High capacity and *flat-nose projectiles* and *shrapnel* are fragmented and ranged, as laid down in the specifications. Shrapnel is also tested in accordance with specifications similar to those of the army.

Target projectiles are ranged, three per lot, at service velocity.

Proof of Fuses and Tracers.—Detonating fuses of various types are tested in accordance with the instructions of the Bureau of Ordnance. All detonating fuses in shell filled with high explosive are fired in a covered butt to prevent the spread of fragments.

All *major, medium and minor caliber tracer* and *ignition fuses* have samples from each lot submitted for test.

The proof consists of several tests which ensure their safety and satisfactory functioning in service. These tests consist of:

1. Drop test.
2. Fragmentation test.
3. Flight test.
4. Plate tests.
5. Tracer test.

The drop test consists of dropping a blind loaded projectile, in which the fuse has been inserted, a distance of 30 feet or more. The fuse must not arm or the tracer, if fitted, ignite.

The fragmentation test is made by causing a fuse to act in a service projectile filled with service explosive.

For the flight test, a projectile loaded with black powder, with the fuse inserted, is fired down the range. The fuse must not act prematurely or in flight.

For plate test, several projectiles, loaded and fused as for service, are fired through plates three-sixteenths of an inch, or above, at service velocity, or below, as specified. The fuses must function satisfactorily in all cases.

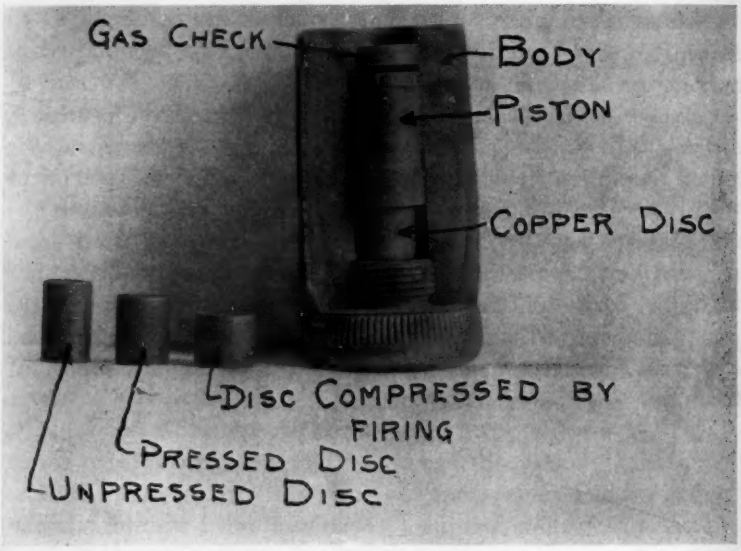

FIG. 5.—Pressure Gage.

For tracer test of fuses so fitted, three are fired in service projectiles at night, down the range. Two out of three must function satisfactorily so as to be followed by the eye for 12 seconds. Two or more timekeepers are used and the gun is served as rapidly as possible.

Time fuses are tested in shrapnel to determine time of functioning and variation from the mean time of burst. They are also given percussion tests at plank, canister test at 0 seconds setting and graze test on a pile of sand. In all cases they must function satisfactorily.

Special fuses are given special proofs, as laid down in the specifications under which they were manufactured.

Proof of Armor.—Armor is proved by determining its ability to withstand the attack of an enemy's projectiles at battle ranges, and the test simulates actual conditions as far as possible. A sample plate from each lot is selected by the inspector at the works of the manufacturer, who chooses the plate expected to give the poorest ballistic results. The sample plate is shipped by rail to the proving ground. Class "A" (face-hardened) plates are set by a large locomotive crane against heavy oak timber structures in front of sand butts. The plate is backed or unbacked in accordance with specifications and is secured to simulate service conditions.

The test is carried out in a similar manner to an armor-piercing shell test. The gun is usually of approximately the same caliber as the thickness of the plate. Velocity and pasteboard screens are used. The projectiles are those known to be of uniform quality. Tubes and plates are placed in front of the plate to prevent the scattering of fragments.

Several rounds are fired. After each, the plate is inspected to be sure that it has defeated the projectile in every respect, as laid down by the specifications. Measurements are taken and recorded, as in the case of shell tests. After the completion of the test, or sometimes after each round, the plate is stencilled with the striking velocities and photographed. (See Fig. 5.)

Plates passing successful test become the government's propterty and are available for test of armor-piercing projectiles. Failed plates are the manufacturer's property and are returned at his expense.

Class "B" plates (special treatment steel, such as turret and conning-tower tops) and protective deck plates are set for test so that the projectile strikes at an angle equal to the anticipated angle of fall of an enemy's shell. As it is impractical to strike a plate in a horizontal position because of the ricochet of the projectile, the plate is set vertically and the projectile caught in a sand butt behind. The plate must not fracture under the impact.

Full reports are made to the bureau of the ballistic results.

Proof of Explosives.—Explosives are tested by using samples of each lot to fragment service projectiles in an explosion chamber. Each sample must function in a satisfactory manner.

Proof of Cartridge Cases.—Cartridge cases are proved by firing sample cases three rounds each, thus ensuring satisfactory

functioning in service. The case must load and eject easily on each round and must be free of deformation, splits or other serious defects.

Proof of Primers.—Primers are proved in accordance with specifications laid down by the bureau. When possible they are tested during current work. Combination primers have several of the proof lot fired electrically and several by percussion. Primers must not misfire, split or rupture. Should they do so, the lot they represent is rejected, and the failed sample primers are returned to the manufacturer.

Proof of Bombs.—Bombs are tested in accordance with specifications, which, as in the case of other material, are to ensure their proper functioning in service. Service conditions are adhered to as closely as possible.

Special Work and Experimental Work.—A definite division between these two classes of work cannot be clearly made. However, such tests as are possible are carried out in connection with proof work. For example, data are collected relative to ranging, erosion, life of guns, new types of ordnance material and questions which have arisen in the fleet. Research and development work are done, using special types of apparatus designed to give accurate results. The proving ground is available for such tests as are desired by officers of the navy to determine definitely points in dispute or in development as to ordnance material or the effect of ordnance material on material under the cognizance of other bureaus. Such tests must receive the approval of the Bureau of Ordnance before being conducted.

Duty.—Duty at the proving grounds is one of the most satisfactory shore details. The work is exacting, but is full of live interest and is in constant touch with modern developments in ordnance. Younger officers of the service considering their first shore details would do well to request this duty, either as a regular assignment or as a part of ordnance postgraduate instruction.

Recommendations.—Once again it is urged that officers at sea or on combatant shore duty remember that the bureau and the proving grounds are anxious to obtain data relative to unsatisfactory functioning of ordnance material. The only way the officers supplying material can know whether it is good or bad in actual service, with the exception of their own experiences, is to receive detailed reports from the officers using the material.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

PUTTING 'EM ACROSS

By LIEUT. COMMANDER K. C. MCINTOSH, P. C., U. S. Navy

"Can you whack her up to fifteen?" asked Moorshead. A thin cough ran up the speaking tube. "I think so, sir, but I would prefer to have the engine-room hatches open at first."—*Their Lawful Occasions*, KIPLING.

Four months before she had been a filthy, black-iron pot, her decks scarred and rotting, her bilges crammed with a rusting jig-saw puzzle made up of parts of every machinery installation formerly on board. The jagged edges of her cylinders leered through the grime of the engine-room in a double row—a huge, abscessed lower jaw throbbing for lack of a dentist. The crippled furniture of the saloons sagged under the staring eyes of the bleared chromo panels in the bulkheads, the ripped cushions spewing dusty horsehair over the torn linoleum.

Now she was in trim gray with a pair of giddy, black destroyers romping along her side by way of camouflage. Her woodwork glistened with much varnish and her cushions smelled of new leather. Down below, the chief was saying hopefully that "she ought to mote—at any rate, she isn't hitting anywhere." Five hundred pink boys, whose overshirts still sat strangely upon unaccustomed shoulders, were watching the stream of khaki coming over the side and sternly resolving that in case they should be seasick, none of the doughboys must be allowed to suspect it. The doughboys were gratefully heaving their packs into the bunks assigned and with clattering mess-kits lining up at the after galley for a much desired supper.

Boatswain's mates began to roar in voices that had not yet acquired a salty raucousness, and flushed second lieutenants began herding the soldiers below and out of sight. The dock suddenly slid away, then the slow throb of the engines showed that the ship was moving. As the sun set, she dropped down the river. That night she was away, slipping out into the dark. Another transport was at work. The navy was putting across

another bunch. In the morning, the continent of America was gone, and soldiers and sailors alike strove to keep the startled look out of their eyes and to appear as if going to sea were an old story. Only one man, a mess attendant who not long ago had been cutting cane in the wilds of St. James Parish, was frankly and ostentatiously miserable. He crouched against the rail of the well-deck, and, between paroxysms of sickness and snatches of audible profanity, he busily read a small Bible. Six big troopships waddled along like plump old ladies, their foam-white petticoats close around thick ankles, and ahead sulked the cruiser convoy, like a mad small boy ordered to show the ladies the way to the post office. Youngsters in khaki were button-holing youngsters in blue and asking many questions. The youngsters in blue, rather than admit that they had never been out over night before themselves, gallantly supplied artistic misinformation. Before night, a new phrase was born. A sergeant had asked him with puzzled face, "Who is that bird who goes around every two hours yelling 'Feed the whale and look out?'" Thereafter, the wheel of that ship was invariably relieved to shouts of "Feed the whale!" and at least one watch officer (Pelham Bay, ex-Bowdoin, 1919) was heard to gravely pass the word in those terms.

The reputation of the sea has suffered much through human haste. Not content to reach the other side, the average traveller would hurry, hurry, hurry—on the broad, open ocean there is no landmark, no point of departure visible by which one may note his rapid and satisfactory progress. Mrs. Fulano, of Chillicothe, is in haste to reach Paris. Atkins, Bull & Co., Ltd., of Liverpool, are clamoring for their cotton. And so the normal ship takes the great circle course across the broad Atlantic and rushes through day after day of gray skies, whistling gales and spiteful seas. The seagoing recollections of most travellers embrace only a port at each end of the run and a weary stretch of "The roaring forties" between.

Over There, the international firm of Foch, Haig, Diaz and Pershing were also clamoring for their freight, but they stipulated that the freight should arrive in good condition. Largely on that account, largely because of the unaccustomed hang of those blue overshirts which still carried faintly the whiff of block camphor, and largely because the chances of finding a

needle decrease geometrically with the size of the haystack used as wrapping, the east-bound transports let the North Atlantic gales roar themselves out unwitnessed and unwept. And there are few bits of seagoing more homely and kind to the neophyte than the long, lazy stretch between Cape Charles and the Rendezvous. Day followed day, a blaze of sapphire underfoot and turquoise overhead, the brilliant sunshine flooding the entire convoy and warming the stunned enthusiasm of the few unfortunates who found the throb of the screws and the smell of paint and tar disconcerting. On first reading their lookout stations bill (it had been snowing in Gravesend) the soldiers had looked fearfully at the foretop with resolute lips and unconsciously tightened fists. After three or four days, the watch in the crow's nest could usually be seen laboriously scrambling up to his station a good half hour ahead of time, while the watch relieved stayed to swap yarns for another half hour—unless a meal was being served below. A stranger catching a glimpse of any of us at almost any time would have looked around for a passing ship flaunting the President's flag, for we sailed with yards, rail, booms and rigging perpetually manned. Wherever was room to sit and swing one's feet, or even to hang solidly by one knee and one elbow, there for 10 hours a day sat or swung a soldier. A submarine west of the Azores would have been spotted at many times torpedo range. The well-decks and alleys were as packed as the alleys of a Chinese city; but just as a Chinese crowd can open out in mysterious fashion to let through a hurrying palanquin or a trotting coolie with his two swinging baskets, so would the swaying mass of brown flannel open and close behind a pair of perspiring messmen staggering along with a huge food-container or a working party on the run to secure a swinging boom. "Comin' through! Hot stuff!" cleared the gangway as effectually as a traffic squad.

Day followed day in exact routine replica, and it is hard to say who furnished most of the humorous flashes that made each day less monotonous; the soldiers, frankly "at sea," or the sailors to whom each day was a new and glorious draft of pure romance. There was discipline of a very complete sort, but like to no discipline hitherto witnessed by the world in arms. Conversation was the rule, and while orders were quickly obeyed and seldom questioned, they were always commented upon in a

fashion that would have filled the soul of Nelson or "Old Jarvey" with unclean dismay. The established method of addressing an officer began with a salute wherein the hand and hatbrim met at a point about abreast the point of the shoulder. Next the hand tilted the hat forward from behind as the fingers scratched in the hair, and the address commenced with a tentative "Why–y–y—" or an explosive "Say!"

The service in the officers' mess-room one morning was most erratic—more so than usual—and all the mess attendants were bubbling with suppressed and gleeful excitement. The senior naval officers ate at a small corner table, and through a long meal filled with inexplicable and exasperating delays, every mess-boy eyed that table. The commissary officer raged among the pantry plates and the cooks bellowed up the dumb-waiter shaft to "take it away," but the boys continued to act as if they had heard that the circus had come to town. After the meal was over and the dishes were being scrubbed, a loud altercation broke out in the pantry and the commissary officer with fiery eye flew in and demanded explanation. Forty boys hung their heads and giggled. Vitriolic orders finally unsealed the lips of the head boy, "Well, suh, this Hanley and this Jones"—a black hand waved toward the two boys in question—"they made bet whose officeh would eat mos'. Bet a dollah. The navigatah, he et twenty-two flapjacks an' fo' pieces toas'. The doctah, he et se'mteen flapjacks, but he et se'm pieces toas'. Now 'ey don' know who win de bet!"

Another boy had his abandon ship station in the boat by which the captain was slated to take passage. At the daily drill this boy would unconcernedly saunter toward his station and evinced no interest whatever in exerting himself toward getting the boat ready to go over the side. Remonstrance of the boat officer brought a look of genuine surprise. "W'y, the captain, he go in this boat, suh. Ev'ybody, 'ey help git this boat off. Ain' no use fo' me to worry. *This* boat git away all right. Git away quick!" "Don't you know," queried the boat officer, "that the captain will be the last man to leave the ship if we're torpedoed?" Mouth and startled eyes flew open. "No, SUH! I didn'. Las' man, huh? Well, if he want me to travel wid 'im, he gotta make bettah arrangements than that!"

Consider the case of Jonnie West. From his cabin on the plains of Oklahoma, Jonnie—the "h" still awaiting him in the school which he had never attended—went to Guthrie to hunt for a job. The most prosperous-appearing individual in sight was a grand big man with lots of gold on his sleeves. Him Jonnie approached, hat in hand, and asked for employment. He got it. Another man in blue and gold put Jonnie through a very embarrassing 15 minutes, then they gave him a paper to sign. "Go say good-bye to your friends and be at the station for the 4 o'clock train," he was told. Hmm! This queer new job involved a journey. Better and better. He was at the station half an hour ahead of time. Observe him now, just inside the door of the commissary officer's room, hat twisting in nervous yellow hands and a great trouble stammering on his lips. He likes the navy, Jonnie does, but somehow he does not seem to succeed in pleasing every one. Three times has Jonnie been on the report, and the last time he has been warned in ominous terms. He does not want to be fired, he wants to re-enlist when his time is up for four more years. And he don't want to be in no brig when we get to where the fightin' is. He finally understands wherein he has offended —those officers' berths are to be made up *before* inspection, not after, and his cleaning work will be lighter and his officers much better pleased if he empties the wash water before it runs over on the deck. But he still lingers in the doorway, and after several false starts unbosoms himself to the effect that he wants to take leave in April, if he can. Unless he has money, he can't. And if he draws his money, he will have none in April. "So if I come ask you fo' my money, suh, will you be so good as to kindly tell me to go to hell, suh?"

Before the week is out, we are living in a new world; a world as strange to old-timers as to neophytes, a world of cheerful compromise and concession to circumstances which nevertheless keeps bright the apparently unattainable ideal. From dawn until dark somewhere about the ship you will find a weary party of those in authority, with spot-lights peering for "food under bunks" or "sputum behind radiator." All day long the beat of the thrashing propellers synchronizes with a monotonous thump, thump, thump of feet as a company of soldiers runs around the deck for exercise. There is room for but one company to run, and we have many companies with us. The running

stops for three-quarters of an hour daily when the bugles wail, "All hands abandon ship!" and the naval boats'-crews, mustered and stationed in two minutes, stare incuriously at gang after gang of soldiers pouring up the ladder to the singsong of "Raft 56! No Absentees! Up that ladder out of the way, please!" Then the bugles sound "Secure" and "Retreat" and within five minutes it starts again, "thump, thump, thump!" At 3.30 the carpenter's gang appear from the compartment of shavings wherein they habitually lurk, and there is heard over the ship the slamming of airports and a hammering as the light-baffles are nailed over the doorways. The sun drops and in an instant the familiar outlines of the smallest compartments and narrowest passages disappear in almost tangible darkness. Here and there a faint blue glow far down the bulkhead makes a barely visible spot to point out the way. Junior staff officers foregather with the carpenter and dispute as to who has the middle watch, and from dark till dawn, through the dense blackness of the decks outside, one of them is continually wandering, looking for a tiny shred of visible light. This is part of the day's work that is taken very seriously. To the last private we know how far the coal of a cigarette may be seen under favorable circumstances. The writer was once told by a sentry: "You must either go in or take off that watch, sir. I can see the dial shining."

Everything is queerly changed in that blue light. At dinner the butter looks like tomato jelly and the pork chops take on an odd, unburied aspect. One peers closely to see whether his glass holds water, lemonade or cold tea. But so strong is human ability to adjust itself to circumstances that the men at first obliged to grope along with outstretched hands are soon playing cards and even reading by the blue lights. It is not difficult after learning to watch the shape and not the color of the cards, for black or red, they all look green.

At dinner in the mess room, a voice rings out of a dark corner over the clatter of groping forks and conversation. We know it is the chaplain, from the sprightly and insinuating way that he shouts, "MAY I have your attention one moment, please? Tonight in this room at 8, Douglas Fairbanks in 'Soldiers of Fortune' and a Mack Sennett comedy. At 7, in Hatch No. 4, Mary Pickford in 'M'liss' and a Kay-Bee feature!" An army

officer at the next table is heard to say half to himself, "So *this* is the war zone!"

The talk over the coffee is as different from any former seagoing as the blue lights are different. Old regulars and ex-merchantmen, starting from common ground of Yangtse pilots or Cape Cod currents, are talking themselves into a new and genuine respect for each other. Youngsters from Pelham follow the swinging argument across the world from Rio Branco to Kennedy Road and keep a machine-gun fire of questions going.

Altogether, it is a very new world, and far removed from the docks a few days—or was it months?—in the past; a world where the souring of the yeast barrels is a hideous tragedy, the phonograph the greatest of man's inventions and the omission of one's compartment from the daily blacklist of the inspection report as great a triumph as being elected President.

It has frequently been stated with much heat by old-style militarists that there is no such thing as *esprit de corps* possible among untrained or partially trained new levies. We are proving every day that that is not so. The sailors carry around in their hearts as great a certainty that we are going to be torpedoed and as great a wonderment as to how they will behave themselves in emergency as any of the soldiers. But the soldiers have a right to worry. Their job is not a seagoing one—a man whose business is with shrapnel and bayonet may be excused for audibly dreading a deep-water bath and a long voyage under oars. With us it is different, and the honor of the navy is gallantly upheld in the fine air of amused toleration and caustic remarks of the bluejackets. "That water looks pretty darned cold," speculates a doughboy. "Hope we don't get a bath we ain't lookin' for." "At any rate," replies Jack, "it's clean water nobody ever used before. Not like the trench-water you'll sleep in all next year." On the other hand, there is fierce jealousy between the army units on board. At any small slip made by a national army man, the militiamen and regulars shake their heads. "Maybe you can get by with that in the national army," they croak, "but WE'D never stand for it." The reply is rather startling, for the national army man immediately comes back with, "Yah, draft evader!" The specialists make the most of their slightly different position. A big man with knotty hands is talking of the glories of his regiment of engineers. "No," he exults, "we

aren't conscripts. Neither are we militiamen," this with fine scorn. "We're all selected men for our jobs." A lean, deeply burned lad, whose bent legs obviously miss the cow-pony upon whose back he was brought up, takes this seriously: "I'm a militiaman," he drawls, "and you're selected right now, you son of a gun!" and his fist thumps on the big man's jaw. Every day the wisdom of the "Old Cattle Man" becomes apparent as concerns his statement of the different kinds of courage, that a man afraid of a gun may be cool and unruffled before a knife. There is one officer in France who wears on his tunic the valor cross, in recognition of the sheer cold-blooded daring he showed in assisting the wounded under fire. And yet that man, when he travelled with us, unsatisfied with the factor of safety furnished by a life-preserver, wore, all across the broad Atlantic, the inflated inner tube of a motor-cycle tire wrapped in a figure of eight around his body; and through the war zone not only never slept, but spent the night in the rigging, as high up as he could climb!

One morning we awake with a sense that something is different. There is a lazy swing to the ship and the engines dawdle along without their customary business-like pulsing. Suddenly the suspicion of a sound, hardly more than a sullen jar, quivers along the bulkheads. Again comes the sound, a little louder as the wind veers slightly. GUNS! Once out on deck we look around in bewilderment for the other ships of the convoy. There is our yoke-mate, though at an unusually great distance; but the others can only be located after sweeping the horizon—two far ahead, two far astern. As we stare, a flash leaps from the side of the distant cruiser and a smudge of white spray shows for an instant where the shell has struck. Astern of our mate something is troubling the water, something that rises and falls like the porpoises that have played around us since we passed Bermuda, but that sticks up like the back of no porpoise we have seen. The convoy is having target practice! We will soon be peppering that plunging spar that our sister ship is towing for our benefit.

Those of us in blue have been waiting for this day to show "Sister Susie" how much better off we are than she. She has 6-inch guns of which she has bragged, but they are old ones. Ours are only fives, but such fives as few ships can boast. Bran

new, and as we like to say, "The shootingest guns for their size ever made." The guns'-crews, transferred to us *en bloc* from a cruiser, all before-the-war veterans, swagger about the poop and forecastle, busily putting a final grooming on their already speckless pets. To the soldiers swarming over the rigging and the raft-nests it seems an interminable time before we begin; and never before has lookout duty been so popular. So many soldiers are claiming that it is their watch in the wing-stations of the fire-control platform that the control officers, range-finder and telephone gangs have to shoulder their way to their posts. But at last we are ready, and the stem swings around as the helmsman sings out his course monotonously. The whistle bellows and the red flag is broken out; and before the sound has died or the flag is fairly shaken out a forward gun cracks spitefully. The shell hits a little short, but to the unaccustomed eyes of the troops it has apparently buried that bobbing spar entirely and they cheer enthusiastically. The next is an over—a bad one. The third is very close, and thereafter shell after shell tears up the water so close that we wonder that no splinters fly. There is a moment's pause before the last shot and as it strikes, a solid log from the target-float flies up. The soldiers yell and pound each other's backs, and a signalman scrambles up to "Sister Susie's" platform and begins to semaphore. All over the ship bluejackets spell out his message aloud for the benefit of the crowding doughboys: "You—shoot—too—well. Why—destroy—my—target?" And the cheering breaks out afresh. Target practice is finished all too soon, and we romp out to get into formation again. But after that day the soldiers look less gloomily at the "pretty darned cold" water. They can now see visions of a conning-tower leaping into the sunshine as did that target raft. Not all the trumps are in Fritz's hand.

Imperceptibly we begin to tighten up. The sea gradually becomes less blue and turns to a troubled gray-green with white-caps here and there, and crashes away from under our forefoot in a way that suggests added speed. Someone figures out we must be nearing the Azores—that we are close to the barred zone. Bluejackets have less to say as they hurry by knots of questioning soldiers. The ship begins to pitch and twist a little. We are beginning to get the channel chop. One morning the order is passed that "beginning to-morrow, all hands will remain fully

dressed and will wear or carry their life-preservers at all times." This begins to look like business.

Through one night of rain-squalls and whistling gusts, the naval lookouts are peering through the dark with a new and vivid interest. All through the night little knots of passenger officers straggle around the decks, staring at the whitecaps that wink and disappear through the blackness, even those least accustomed to the sea feeling pleased that the waves are rising. It is uncomfortable, perhaps, but the higher the seas, the harder it will be for Fritz. The lookouts report many things that night, nothing they can definitely name, but a shape or disturbed water —something that looks alive. Then suddenly the faint flash of a blinker-tube snaps through the rain, then another and another. The destroyers are here! Those who are about the decks in the gray, dripping dawn see the cruiser that has led us across spin on her heel, shake a few more revolutions out of her impatient engines and head back along our trail—going home for another convoy. And as the light grows, one after another the flotilla appears, formless and indistinct in their wild war-paint, scrambling over the whipped wave-crests and sinking out of sight in the troughs, scurrying here and there around and ahead and astern of us like busy, questing terriers. Very tiny they look—incredibly tiny to be out in such a sea—but very self-assured and competent. In long swooping zigzags two search the sea far ahead. On both sides of the convoy others nose here and there, so that, however we are heading, there is always at least one destroyer between us and the swaying horizon. Astern, two more trot back and forth, back and forth, dancing like corks across our boiling wake. Our own engines are singing a new tune in a booming bass that makes the whole ship quiver. Our new-world feeling of isolation vanishes with a jerk. We are in the big world again, the real world. Just a little way over there is France, and we are now, *now* in the danger zone. Fritz may be watching our smoke from the horizon even now.

Very few even of those who ran the war zone regularly retain any cohesive recollections of it. Days and nights are merged in the memory into an interminable, yet somehow short, period of vibrant alertness, a steadily increasing tension. How many days and nights it lasted we know only from the ship's log. In retrospect it would seem something less than 24 hours that was

spent zigzagging among the careering destroyers, except that the recollection of the feel of our clothing is so vivid. The wettest and most exhausting duty could never in 24 hours cause wool, kapok and oilskin to grow so solidly to the skin, to become so unpleasantly an integral part of ourselves. We have bragged in the past of the soft weave of the knitted "socks from sister," but now every yarn and every stitch prints itself deep into the indignant skin. If we weren't so excited, so masculinely happy, we would be horribly miserable. This is the part of the game we were afraid would be too much for us—we have wondered how we would stand the gruelling discomfort. We find we can stand it very well, especially when we contemplate how much worse we'd feel if we were running the zone in one of those crazy, bedizened little cockboats of the escort. So we weary ourselves unduly through our fear of missing something. We watch the sea till our eyes ache with stinging spray or glaring sun. We stiffen to attention like a scenting hound when a lookout reports "Object in the water, sir!" and only partially relax with relief and disappointment when the destroyer who has dashed off to investigate finds only a floating spar or a patch of weed. When we sit down to eat, we find with amazement that we are very tired. When we lie down to sleep, we do so with ears strained; and when we finally drop into a dreamless, druglike coma, we are still straining our ears. The clang of a dropped slice-bar in the fireroom brings us instantly awake and abnormally sentient. And will any of us ever forget the time when the weary striker in the radio room, after being relieved, went to sleep where he sat and leaned against the button of the general alarm gong? That sudden and unexpected clamor caused a cold dinner for most of us, but we were all glad it happened, for as we found on checking up, the last soldier was at his abandon ship station in two minutes and a half. Snappy, I guess. No sign of a panic, either. Curiously enough, it is the wakeful nights that seem short, while the days drag interminably. Our eyes have learned an uncanny trick of seeing all around our heads, and what they see stands out with stereoscopic clarity and brilliance. There is so much and yet so absolutely nothing to see.

One morning the convoy splits in two, the three biggest ships veering away to the northward while we continue on our course. St. Nazaire it is—that point is settled. And we ought to be

there TO-MORROW. "Get by to-night, get by forever," remarks the boatswain, and then with instant mental association, "Do they have hot and cold water in French bathrooms?"

To-morrow comes, and with it the lee of the land. The wind has died with the sea, and so placid is the air and water that it seems that the coast must be visible. We breakfast, muster and clean house, and for once, it being the last day, those in authority dispense with spot-lights, and cease harassing compartment cleaners. By the end of the morning, most of us have finished our chores, and with life preservers unfastened are basking in the sun and watching for the land, eyes shining with anticipation from faces pallid with sleeplessness. We have "got by" the last night out and are beginning to relax just a little.

The siren of the ship to port screams insanely and a stern gun thrashes a shell into the water off her quarter. Bugles burst into a nasal chatter and all hands jump to battle stations. The line of soldiers on the booms begin to shout and point at a swirl in the water, as the destroyers leap like live things and race for the spot where the shell has fallen. Even in their sudden mad hurry, their cool-headed plan is shown, for while one jumps in full cry right at the trouble-spot, the others whisk a smoke screen across our stern. The leading destroyer whizzes on, then turns sharply, and as she turns, the tortured water cracks and roars with the burst of the depth bomb she has dropped. Back over the same ground she flies, and again looses a bomb, spinning on her heel to slam three quick shots into the smother of the explosion. Then head up and tail erect, she slips back into her place in formation, leaving a coal-burner that has apparently broken all records getting down off the horizon to sniff around questioningly at her leisure. An army officer who through the long voyage has had many tales to tell looks at his watch regretfully. "Just 11 minutes," he explodes, "and that fellow over there has had more fun than I ever had in my whole life!" At that moment, a long yell comes from aloft of "Land ho!" and we turn to see the gray shoulder of Belle Isle lifting above the horizon. Our cup of bliss is full. What does it matter to us that subsequent investigation seems to make of our submarine merely a floating spar and our naval battle just a little swank from the destroyer's skipper? To us, there is nothing more needed. We have had a brush with Fritz, we have seen his tin

fish rent to bits, and yonder in plain sight is FRANCE! That night the anchor rattles protestingly down into French mud and the ship is strangely still, for everybody, scrubbed to the blood, has climbed precipitately between the sheets and is fathoms deep in sleep.

Very strange and empty and enormous the ship felt on the way home, and in spite of the snarling gales of the northern route we took, it was a clean and shining transport that raised the coast of the United States. One could notice as the first liberty party swung up the docks to catch the subway for Manhattan that their overshirts *fit;* and in their faces was the calmness of men who have proved themselves. There was no more speculation and secret doubt. "Leave it to us," those faces seemed to say. "Bring on your doughboys as fast as you can make 'em. We'll put 'em across." And they did.

DISCUSSION

Increasing the Size of Battleships

(See Page 387, Whole No. 193)

Rear Admiral Seaton Schroeder, U. S. Navy, Retired.—The able paper by Captain E. J. King, U. S. Navy, on "The Effects of Increasing the Size of Battleships," in the March number of the Proceedings, commands a most interested attention. And conviction attends the reading of most of the statements and conclusions expressed.

On one point, however, there is, I think, room for discussion. That point is contained in the sentence, "Also the larger ships should be better gun-platforms, especially in heavy weather." The superiority of larger ships in that feature is dwelt upon throughout the paper, and it seems to be a generally accepted fact in professional discussions. The question in my mind is, "Are we sure that the statement is correct?" I must say that I am not sure; in fact, I incline to think that it is a mistaken notion as applied to ships to meet our particular needs.

As stated in the article, increase of size must largely be gained by increase of length and of beam, because any appreciable increase of draft is prohibited by the depth of water available, or likely to be available, in harbors and channels leading to our navy yards. Increased beam undoubtedly tends to increase stability, but it does so at the cost of steadiness; the two are antagonistic. The diminution of steadiness may be explained either by putting it that the deck of the broader ship follows more closely the surface of the waves, or by the more fundamental statement that the broader ship has a greater metacentric height. Even supposing, however, that by some inspiration the naval designer were able to shift his weights so as to appreciably raise the center of gravity and thus decrease the metacentric height, the result would still not be satisfactory, for the reason that winging the weights, either laterally or vertically, increases the roll after it is once started.

A condition is generally more convincing than a theory, and the first appeal on this subject was made to me by a condition. In the spring of 1906 a battleship, which I was to command later, was being swung for compass adjustment by the builders off the Capes of Virginia. I was surprised by observing a marked and disconcerting motion, while the sea seemed quite smooth; close attention then detected a long slight swell heaving. I spoke of it afterwards to the superintending naval constructor at Newport News, suggesting that the ship's behavior betrayed a considerable metacentric height, and I was told that the computations were not at hand, but that I was undoubtedly right and that it would probably prove to be something around 6 feet. This turned out to be about right, as well as I

can remember. And, also, as well as I could judge, the motion was greater than what I had observed with smaller ships under the same conditions.

As the size of ships has increased, the question of limiting the draft has come to the fore, and an interesting comparison came under my observation later. One pair of sister ships (battleships), in which restriction had been placed upon the draft, were seen, when in column, to roll considerably more than another pair which were a little larger, but of a draft much heavier in proportion. I have not had personal opportunity to see the performance of the heavier tonnages built since that time; but from what I have been told, I gather that certain ships of 11,000 tons more displacement and 15 feet more beam and 2½ feet more draft have proved very lively in heavy weather, while two vessels of a displacement about midway between those extremes, but with 7 feet less beam and 6 inches more draft than the heaviest of those mentioned, are fairly easy.

All this is not very precise, and therefore not very convincing; but as we get above 30,000 tons the contrast between performances becomes greater, the increase in size and beam being out of proportion to any slight increase of draft that may be considered expedient. We should not go far above present figures without trying to reach some positive decision as to what the result will be. Especially should we guard against assumptions in problems in which the conditions change; we may be insensibly led on in a certain path without noting the effect of the advance in that path, and taking heed perhaps mostly of the progress in the mechanical arts which has made possible the great increase in size and power. After the battle of Lissa, in 1866, when the *Re d'Italia* was fortuitously rammed and sunk in the smoke of that rough and tumble Donnybrook fair engagement, attention became centered on the ram and the ram bow, and it took nearly half a century to remove the obsession and leave it clear that the danger to own ships in formation and to docks and piers, and the inconvenience in mooring and unmooring, more than offset any remote possibility of using the ram in action. Indeed, the acceptance of that weapon was so general as to cause it to be regarded as a means to an entirely different end; upon one occasion, when I ventured a protest against handicapping a ship with that dangerous excrescence, I was told that that increase of length underwater was necessary to ensure obtaining the required speed.

That increase of size must produce a steadier gun-platform seems a manifest truism, provided other elements remain the same; but, after determining the suitable proportion of beam to draft, any material departure from it changes the problem. It may be found, if it has not already been found, that, with normal distribution of weights and fullness of body, there is a critical ratio of beam to draft which should not be exceeded in solving the problem of steadiness.

In this connection it is to be observed that if two vessels, one drawing normally several feet less than the other, should be wounded seriously, the deeper draft vessel might be unable to enter a port and dock accessible to the other.

The advantage of higher command is conceded, of course; but in displacements larger than what we now have the increment will be small; in

fact, I understand that in the recent conversion of some of our predreadnoughts into one-caliber ships, the elimination of the broadside guns has left the remaining battery as a whole possessed of a very fair command.

In the matter of concentration of fire by more smaller ships on a less number of larger ones, or distribution of the fire of less larger ships against more smaller ones, there are several things to be considered. A ship distributing her fire against two targets can do it well enough as long as two spotting or fire control stations are working well; but if one is knocked out the distribution will be affected. On the other hand, two ships concentrating on one can certainly maintain the fire in satisfactory succession. In 1909, at the first battle practice ever tried by our fleet in which concentration of two, and more, ships was attempted, it became evident that certainly two and probably three ships properly trained could alternate salvos efficiently. Those were pioneer days, and what we did fairly well then (somewhat to the surprise of the Naval War College, I understood) can certainly be much better done now; and then there will be the security of having a spare fire control station.

If some of the advantages claimed for greater displacement are denied to ships materially larger than those of the present fashion, thus diminishing the tactical superiority claimed for them, there will naturally be corresponding increase in the importance of strategic features, expanding the scope of strategy to comprise world-wide operations. This may lead to more favorable consideration of the possible importance of diffusion. Of course, either extreme—excessive diffusion or complete concentration—is impossible of serious consideration; there may be compromises affected by political and diplomatic situations of individual countries. With us, the exigencies of world politics and the demands of various parts of our somewhat far-flung national or state interests may have an influence in shaping our program of construction; but we must not lose sight of the fact that control of some particular area may be decided by a fleet action in a different part of the world, and fleet efficiency should not be impaired either by building ships smaller than is necessary or by vitiating their individual tactical qualities by making them too large.

U. S. NAVAL INSTITUTE PROCEEDINGS NO. 191

ACCURATE TRAJECTORIES BY MECHANICAL INTEGRATION

By Captain E. F. Eggert, C. C., U. S. N.

TYPOGRAPHICAL ERRORS

Page 72, line 25, the expression $\frac{1}{2} \times t^2$ should be $\frac{1}{2}k \times t^2$.

Page 76, in the title under Sheet A, C should be c, and 8 should be 8. There should be a note that the solid curves are for 16" and the broken curves for 14" projectiles.

Page 77, line 20, the expressions r_h and r_v should be $r_h dt$ and $r_v dt$.

Page 80, Sheet B, the headings p, p_h, and p_v should be r, r_h, and r_v.

U. S. NAVAL INSTITUTE

SECRETARY'S NOTES

Change in Board of Control

Colonel Dion Williams, U. S. M. C. tendered his resignation as a member of the Board of Control upon being detached from duty in the United States and his resignation was accepted by the Board with regret on April 8, 1919.

Membership

Life, regular and associate membership, 5778.
New members: 28. Resignations: 34.
Deaths:
Lieutenant E. Q. Horton, U. S. N.
Ensign J. W. M. Simmons, U. S. N.

Dues

The annual dues ($2.50) for the year 1919 are now payable.

Regular and associate members of the U. S. Naval Institute are subject to the payment of the annual dues until the date of the receipt of their resignation.

Address of Members

All members are urged to keep the Secretary and Treasurer informed of the address to which PROCEEDINGS *are to be sent, and thus insure their receipt.* Members and subscribers are urged to notify the Secretary and Treasurer promptly of the non-receipt of PROCEEDINGS, in order that tracers may be started. The issue is completed by the 10th of each month.

Book Department

The Institute Book Department will supply any obtainable book, of any kind, at retail price, postage prepaid. The trouble saved the purchaser through having one source of supply for all books, should be considered. The cost will not be greater and sometimes less than when obtained from dealers.

Reprints of Articles

The attention of authors of articles is called to the fact that the cost to them of reprints other than the usual number furnished, can be greatly reduced if the reprints are struck off while the article is in press. They are requested to notify the Secretary

and Treasurer of the number of reprints desired when the article is submitted. Twenty copies of reprints are furnished authors free of charge.

Illustrations

Authors of articles submitted are urged to furnish with their manuscript any illustrations they may have in their possession for such articles. The Institute will gladly co-operate in obtaining such illustrations as may be suggested by authors.

Original photographs of objects and events which may be of interest to our readers are also desired, and members who have opportunities to obtain such photographs are requested to secure them for the Institute.

Notice

Whole Nos. 6, 7, 10, 13, 14, 15, 17, 145, 146, 147, 149, 155, 166 and 179 of the PROCEEDINGS are exhausted; there are so many calls for single copies of these numbers that the Institute offers to pay for copies thereof returned in good condition at the rate of 50 cents per copy.

ANNAPOLIS, MD., APRIL 15, 1919.

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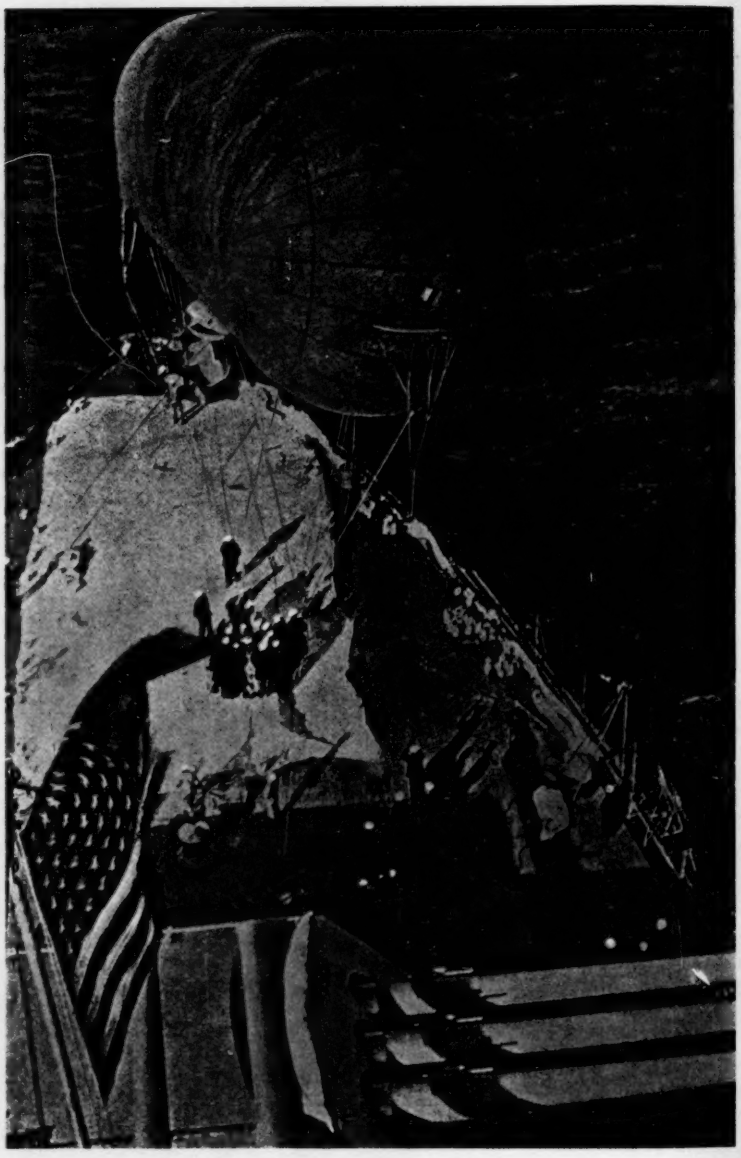

KITE BALLOON ON U. S. S. "OKLAHOMA."

The use of aerial observers with the fleet has become very pronounced during the war and fleet maneuvers.

PROFESSIONAL NOTES

PREPARED BY

COMMANDER S. A. TAFFINDER, U. S. Navy

GENERAL ARRANGEMENT

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GREAT BRITAIN

GRAND FLEET CHANGES.—With the dispersal of the Grand Fleet squadrons and flotillas from the northen bases it is expected that an alteration will be made in the grouping and designation of the Fleet. The title of "Grand Fleet," instituted for the war, will be dropped, and the forces in home waters will probably be known, as before August, 1914, as the "Home Fleet."

The battle-cruiser fleet as such will also disappear, the battle-cruisers forming one squadron with two divisions. Vice-Admiral Sir William Pakenham, commanding this fleet, with his flag in the *Lion*, was expected to be relieved at Davenport yesterday (Friday) by Vice-Admiral Sir Henry Oliver, who since March, 1918, had flown his flag in the *Renown* in command of the light battle-cruiser squadron of the fleet.—*Army and Navy Gazette* 3/1.

TORPEDO BATTERY ON "REPULSE" AND "RENOWN."—A novelty is the adoption of the all-centerline position for the torpedo battery of eighteen 4-inch guns, which are mounted in three-gun shield mounts, open to the rear. Also the director-fire principle has been applied, all the guns being trained and elevated from a single fire-control station by the fire control officer.—*Scientific American*, 3/15.

PROPELLING MACHINERY—BRITISH "K" BOATS.—The main propelling machinery of the "K" boats consists of two sets of single reduction geared steam turbines and two boilers of the straight-tube three-drum type, having a working pressure of 235 lb. per square inch and arranged for burning oil fuel. Each set of turbines consists of one high-pressure and one-low-pressure cylinder, both turbines driving the main line of shafting by double helical gearing. An astern turbine is incorporated in each low-pressure turbine. The full power ahead shaft speed is 400 r. p. m., the corresponding turbine speeds being, high pressure 3500 and low pres-

sure 2800. The main motors, wehich are in the wings of the ship, somewhat above the shaft centers, are also connected to the propeller shafting by double helical gearing, the ratio in this case being two to one. The turbines can be declutched from the line of shafting when desired, while clutches are also fitted between the main motors and the shaft line. This latter set of clutches must be disengaged when the main shaft is running at above 220 r. p. m., and this unclutching is carried out by hand or automatically by governor gear. The turbines are installed in a separate compartment, watertight bulkheads being provided at the forward and after end of the compartment, with two doors in the former, one for access to the boiler room and the other to the main passage way to the forward part of the vessel; and one door in the aft bulkhead leading to the motor room.

The boiler room contains, in addition to the boilers, the feed pumps, oil-fuel pumps, heaters and filters, and forced-draft fans, the latter being driven by impulse steam turbines. A hinged funnel is provided for each boiler, arranged so that it may be lowered into the superstructure and the opening closed by a strong steel cover, both operations being performed simultaneously by means of an electric motor placed in and operated from the turbine room. In later boats a hydraulic semi-rotary engine is used. As a precaution against accident in the event of the funnel covers being damaged, an additional valve of special design is fitted on the hull of the vessel at the base of the funnel uptake. The covers for making watertight the air vents in the boiler rooms are hydraulically operated from the boiler room. In later boats of the class these covers are in duplicate. Arrangements are provided for shutting off the supply of oil fuel to the boilers before the funnel opening can be closed. The turbines, boilers and all hot surfaces are carefully and thoroughly lagged with incombustible, non-conducting material, with the object of reducing the temperatures in the engine room and boiler room to a minimum, and an efficient system of ventilation is provided throughout the machinery compartments.

For cruising, it is possible to use an eight-cylinder, 800 brake horsepower oil engine of the submarine type. This engine drives a dynamo which can be used for charging the batteries and for driving the ship at cruising speed by electrical transmission to the main motors. The auxiliaries for the oil engines are on the same lines as those fitted in ordinary submarine practice.

The auxiliary machinery in the ship is of the usual pattern for submarine service, though somewhat larger in cases. Two compressors are fitted for charging the 2500-lb. high-pressure air bottles, of which over 100 are fitted in the vessel. One of these compressors is motor driven and the other is direct driven from the end of the generator shaft. Two low-pressure air compressors are fitted for supplying air for blowing the water from the main ballast tanks when the vessel has broken surface. Two three-throw double-acting reciprocating bilge pumps, driven by electric motors, are also fitted for pumping the tanks and bilges. The telegraphs are of the ordinary mechanical type fitted with electric bell replies.

A special feature of these boats is the fitting of hydraulic power for various operations, such as working vent valves in the ballast tanks, air intakes in the boiler room, and the raising and lowering of the periscope rams and wireless masts. In the later boats this system is also applied to the funnel covers. The steering gear, and also the forward and after hydroplane diving gears, are operated by means of motor-driven Variable-Speed Gear Company's hydro-electric units, one for each service, controlled from pedestals placed in the control room. Hand gear is fitted in each case for emergency use. The steering gear itself is of the usual submarine screw-gear type.

The forward hydroplanes are of the housing type, the planes sliding inboard along the shaft into the superstructure to protect them from heavy seas and during high-speed running on the surface. This operation is effected by hydraulic power, but hand emergency gear is also fitted.

The torpedo equipment of these vessels consists of four 18-inch torpedo tubes in the bow and four 18-inch broadside tubes. In later boats of the class the bow armament equipment consists of six 21-inch torpedo tubes.—*Engineering*, 2/28.

DESTROYER'S HIGH SPEED.—*Nearly Forty Knots.*—H. M. destroyer *Turquoise*, built by Messrs. Yarrow and Co., has just passed her official trials on the measured mile at Skelmorlie, when a speed of 39.6 knots was obtained during four hours' continuous steaming. The *Turquoise* was fully equipped, and had fuel for a run of 1000 miles at cruising speed. It is understood that this is the highest speed yet obtained by any destroyer.—*London Times*, 3/18.

BRITISH 18-INCH NAVAL GUN.—Describing the British 18-inch gun, the largest naval gun in the world, which was built and placed aboard monitors and which was used in bombarding Ostend, the London Engineer gives the following interesting facts: "The special mounting allows an elevation of 45 degrees, in which position the gun has a range of nearly 50,000 yards, or say 30 miles. The projectile stands close on seven feet in length, and weighing 3600 pounds, has a long 'wind-cheating' cap. The fact that a gun of this enormous weight could be mounted on board such a vessel as the *Lord Clive*, in addition to her armament of two 12-inch guns, without seriously affecting stability or trim, says much for the generous lines and substantial construction of the monitor type. The shell, when capped and fired and striking normally, is capable of perforating armor of the following thicknesses, the shell itself emerging unbroken on the other side of the plate: (a) At point-blank range, no less than 41 inches of hard-faced armor. This is equivalent to a wall of unhardened steel of about 54 inches (four feet six inches!). (b) At ten miles and 20 miles, respectively, 22 inches and 12½ inches of hard-faced armor of the latest and best type. (c) Finally, at the extreme range of no less than 30 miles, armor of ordinary steel having a thickness of close upon one foot. As a matter of fact, the shell in actual trials perforated a hard-faced plate of a thickness nearly equal to its caliber at a velocity equivalent to a range of about 14 miles. Thus the heaviest armor afloat, when attacked by it, would not be much better than a piece of cardboard. Officers who were on board the *Lord Clive* during the final bombardment of Ostend, state that the discharge of the 18-inch piece had no apparent effect on the structure of the vessel, and the blast was felt only at the extremity of the forecastle. No fittings were injured nor was any damage sustained by the two searchlights, which, as shown in our engravings, are placed directly abaft the 18-inch shield. Unfortunately—or otherwise—the armistice intervened before this tremendous weapon had fired many rounds at the hostile positions, but judging by its first performance it has a distinctly promising future. Even with reduced charges its range appears to be much superior to that of the smaller naval guns, and it need hardly be said that the shattering power of the 3600 pound projectile is very great. Whether this gun will reappear in the capital ship of the near future remains to be seen."—*Army and Naval Journal*, 3/29.

In spite of the bad weather exceptionally good work has been done recently by the mine-sweeping flotillas. They have destroyed about 5500 mines since the armistice, and about 100 mines a day continue to be swept up. Following the Russo-Japanese War of 1905 and the Tripoli War of 1911, stray mines were found as late as two or three years after hostilities ended. Risk of similar happenings around our coast must be

eliminated. Our own protective minefields must be lifted no less than the floating traps laid by the Germans. Mine-sweeping is an affair of vital national importance. If sufficient trained men volunteer for the new Mine Clearance Service, the fishing grounds and trade routes may be cleared by the autumn for traffic to move normally.—*London Army and Navy Gazette*, 3/22.

THE INTERNED GERMAN SHIPS.—The question of what is to be done with the German Fleet now interned at Scapa Flow is apparently still unsettled by the Peace Conference, which finds the problem no easy one to solve to the satisfaction of all the Powers interested in the fate of the ships. The American delegation, however, have put forward a memorandum explaining their views, from which it seems that the only difference between the American and British attitudes is that, whereas the country favors the destruction of the ships forthwith, the Americans advocate them being "sold as junk." Cogent arguments against the proposal to divide the vessels amongst the Allied Navies are set forth in the American memorandum. Such a distribution would increase the naval armament of the Powers by about 30 per cent; and this is rendered unnecessary by the removal of the German and Austrian menace. It is impossible to find a method of distribution which would be regarded as equitable by all, and as the German ships are of short steaming radius, built to fight near home, and are dependent upon German shops and yards for maintenance, they would be uneconomical and inefficient as part of any foreign navy, apart from the fact that they will soon be obsolete with the possible exception of the *Baden*.

As a compromise between the American idea of selling the ships as scrap iron and the British plan to sink them, there is a means of disposing of the hulls which would give a useful return to the Powers without raising awkward questions of inequitable division. This is to allow all the Allied Navies to use them as targets. Trials could be held at which the ships of all nations concerned, with guns of varying caliber and power, could be utilized.—*London Army and Navy Gazette*, 3/29.

GERMANY

THE FATE OF THE "DEUTSCHLAND."—The mystery which hitherto has surrounded the whereabouts of the merchant submarine, the *Deutschland*, has at last been cleared up. In June, 1917, the vessel was rammed by an English ship, in the Mediterranean.

Captain John Thompson of the British mercantile marine, who, for a long time, had been called "Deutschland Thompson" by his comrades, acknowledged the deed during a visit to New York. The British Admiralty gave him a reward of 1000 pounds (20,000 marks), and the D. S. O. (Distinguished Service Order) was conferred upon him by King George. when asked in New York for details, he answered: "I am the man that sank the *Deutschland*, but I may not talk about it." At that time the war was still in progress, but assuredly there were no grounds for this silence. Others, who knew the captain, and had been on voyages with him, have told more of his experiences.

In 1915, when Thompson was in command of a merchant ship, he was stopped by a German submarine in the Bay of Biscay. An officer came on board and questioned him concerning his cargo. The information given by Thompson failed to satisfy the U-boat officer, and he called the Englishman a liar. In English this word used in such a manner is considered a deadly insult. Thompson was furious, let fly at the German officer and knocked him down. When two German sailors had helped him to his feet, he drew his sword and wounded Thompson in the left hand the forefinger of which is still stiff.

In June, 1917, we learn Thompson went in another ship from Malta to Alexandria in Egypt. A large submarine, which appeared to be lying in wait, was sighted. The English vessel was unarmed and the only way of escaping the danger was to try to ram the U-boat. For more than an hour, the two ships circled around each other, mutually intent on gaining the advantage. The German submarine fired several shots, which did very little damage. Finally, the English ship managed to steer straight at the submarine and cut it in two. It was known that the former merchant submarine, the *Deutschland*, had been armed and was cruising in the Mediterranean, and from the unusual appearance and the size of the rammed submarine, Thompson decided that it must be the *Deutschland;* later, life-belts, etc., were picked up which, in fact, bore this name, so that there is little doubt as to the identity of the ship. In March, 1918, a vessel commanded by Thompson was torpedoed near the Azores, and Thompson was prisoner for some 40 days on board a German U-boat. Fortunately, says the English reporter, the Germans did not know that their prisoner was the man who had sunk their finest U-boat, with its crew of 100 men. Probably this Englishman imagined that it was this fact alone which saved him from being flayed alive—instead, as actually occurred, of his being set free, there being no room for prisoners on board our submarines.

Through these reports, the truth of which the gift of money to Thompson, and the fact of his being decorated, seem to confirm the rumors current in the press that the *Deutschland* had seen captured and was lying in an English port, were put an end to. It is characteristic of the English that they made no effort to save any of the one hundred men of the crew—only life-belts were picked up, not a man. When he himself was torpedoed, Thompson had the good fortune to have one of the "barbarous Huns" as an opponent, who sheltered him for 40 days.—*From German Press.*

AERONAUTICAL.—*Gothas for Great Britain.*—As soon as the circumstances permit, three of the German airplanes of each type surrendered under the terms of the armistice will be flown to England for exhibition purposes. The number of airplanes required from Germany is far from having been reached. In many cases the machines were found damaged or deficient in instruments or parts. On the British sector the proportion of large bombing planes—only about 20—left by the Germans is very small. The examination of all the planes surrendered has added to the accumulated evidence that in armament, fittings, and accessories of all kinds British aviation had completely outstripped the German air service. The total number of airplanes collected by the British Air Service is just over 500. About 170 were abandoned in open railway trucks and were left dismantled—a clear evasion of the armistice terms, and evidence of the hostile spirit in which Germany submits to the inevitable.—*Scientific American,* 3/29.

NAVAL TERMS.—The naval clauses of the Peace Treaty have been but very slightly amended, but it may be well to review them in slightly more detail than has yet been done.

All the clauses which relate to the fate of the warships to be surrendered by Germany are still subject to the reservation that the Allies have not yet come to an agreement whether or not the ships should be destroyed or broken up or used to make good Allied losses during the war. The object aimed at in settling the naval clauses was exactly the same as that which inspired the drafting of the military terms—namely, the reduction of the German naval strength to the requirements of police and frontier control. Perhaps the chief feature of the German fleet as it will be left after the stipulations of the treaty have been observed is that it will have no submarines.

The German fleet will consist of six battleships of the *Deutschland* or *Lothringen* type, six light cruisers, 12 destroyers, and 12 torpedo-boats in commission. All other warships, whose fate has not otherwise been

settled, must be placed out of commission or used for trade. In replacing units of the seagoing fleet it is laid down that vessels built shall not exceed 10,000 tons for armored ships, 6000 tons for light cruisers, 800 tons for destroyers, and 200 tons for torpedo-boats, and unless ships be lost no *Ersatz* battleship or cruiser can be built until the vessel it replaces is 20 years old, and, in the case of destroyers and torpedo-boats, 15 years from the date of launching.

The personnel of the German Navy, including land staff and officers, must not exceed 15,000, and there must not be more than 1500 officers and warrant officers.

All other German warships which are not in German ports cease to be German, and vessels interned are regarded as being finally given up, and warships under construction shall be broken up under the supervision of the Allies.

One clause, which, as already stated, is subject to reservation, provides that the following ships, with all guns aboard, shall be sunk:

Battleships.—*Oldenburg, Thuringen, Ostfriesland, Helgoland, Posen, Westfalen, Rheinland, Nassau.*

Light Cruisers.—*Stettin, Danzig, München, Lübeck, Strassburg, Augsburg, Kolberg, Stuttgart.*

Forty-two modern destroyers and 50 modern torpedo-boats.

All auxiliary cruisers are to be disarmed and treated as merchant ships. All submarines, submarine salvage vessels, submarine docks, including the Kiel tubular dock, will be handed over. Here, again, there is a reservation as to what shall be done with these craft. The material derived from the breaking up of the German warships must not be sold to foreign countries and can only be used for industrial purposes. Germany is forbidden to buy warships from abroad, or to buy or construct submarines even for commercial purposes. Naval war material, including such things as mines and torpedoes, will be fixed by the Allies, and all stocks in excess of those limits must be surrendered. Germany will be called upon to sweep certain areas free of mines.

The principle of voluntary service is also applied to the navy and petty officers, and men must serve a minimum period of 12 years. There is the same stipulation as to the length of service of officers as figures in the military terms. There is a provision forbidding the war training of officers and men of the mercantile marine.

In drafting the naval terms the necessity of obtaining free access for all nations to the Baltic has been borne in mind, and Germany will be called upon to demolish the fortifications commanding the passages to the Baltic and to place its hydrographical information with regard to the channels between the Baltic and the North Sea at the disposal of the Associated Government. The coastal defences and fortifications on German islands within 50 kilometers of the German coast will be treated as defences, and there is a stipulation that no fresh fortifications are to be constructed within these limits.

There is a provision prohibiting the use of wireless high-power stations for naval, military, and political messages without the consent of the Allied Governments.

The fate of the Kiel Canal has not yet been settled, nor has that of Germany's submarine cables.

With regard to Heligoland, the clause dealing with which is also subject to reservation, it has been pointed out that the destruction of the harbor and Heligoland might entail suffering to the fishing fleets which find refuge there in bad weather, and this question is still to be disposed of.—*London Times*, 3/20.

UNITED STATES

NAVY DEPARTMENT—BUREAU OF CONSTRUCTION AND REPAIR

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—DEGREE OF COMPLETION, MARCH 31, 1919

Type, number and name	Contractor	Per cent of completion			
		Apr. 1, 1919		Mar. 1, 1919	
		Total	On ship	Total	On ship
Battleships					
42 Idaho	New York S. B. Co.	Del'd 3,	24/19	99.7	99.7
43 Tennessee	New York Navy Yard	68.4	64.4	64.2	58.2
44 California	Mare Island Navy Yard	57.2	45.9	55.6	42.8
45 Colorado	New York S. B. Co.	16.4	2.1	13.7	1.8
46 Maryland	Newport News S. B. & D. D. Co.	44.1	34.6	41.8	32.4
47 Washington	New York S. B. Co.	12.4	1.7	10.1	1.2
48 West Virginia	Newport News S. B. & D. D. Co.	20.5	2.2	19.1	2.2
49 South Dakota	Navy Yard, New York	0.	0.	0.	0.
50	Navy Yard, New York	0.	0.	0.	0.
51 Montana	Navy Yard, Mare Island	0.	0.	0.	0.
52 North Carolina	Navy Yard, Norfolk	0.	0.	0.	0.
Battle Cruisers					
1 Lexington	Fore River S. B. Co.	....	....	0.	0.
2 Constellation	Newport News S. B. & D. D. Co.	....	....	0.	0.
3 Saratoga	New York S. B. Co.	....	....	0.	0.
4 Ranger	Newport S. B. & D. D. Co.	....	....	0.	0.
5 Constitution	Phila. Navy Yard	....	....	0.	0.
6	Phila. Navy Yard	....	....	0.	0.
Scout Cruisers					
4	Todd D. D. & Const. Co.	25.	1.6	24.5	1.15
5	Todd D. D. & Const. Co.	22.5	1.4	22.	1.
6	Todd D. D. & Const. Co.	18.2	.9	17.6	.6
7	Union Iron Works	0.	0.	0.	0.
8	Union Iron Works	0.	0.	0.	0.
9	Wm. Cramp & Sons Co.	9.	....	9.	0.
10	Wm. Cramp & Sons Co.	9.	....	9.	0.
11	Wm. Cramp & Sons Co.	0.	....	0.	....
12	Wm. Cramp & Sons Co.	0.	....	0.	....
13	Wm. Cramp & Sons Co.	0.	....	0.	....
Miscellaneous					
Fuel Ship No. 16 Brazos	Boston Navy Yard	91.	90.3	89.	88.
Fuel Ship No. 17	Boston Navy Yard	20.2	.5	17 8	.1
Fuel Ship No. 18	Boston Navy Yard	.2	.2	.1	.1
Gunboat No. 21 Asheville	Charleston Navy Yard	78.7	76.7	74.3	73.3
Gunboat No. 22	Charleston Navy Yard	0.	0.	0.	0.
Hospital Ship No. 1	Phila. Navy Yard	26.	12.5	25.	10.
Amn. Ship No. 1, Pyro.	Puget Sound Navy Yard	80.	72.	72.	62.
Amn. Ship No. 2, Nitro.	Puget Sound Navy Yard	32.	8.	18.	0.

There are 195 destroyers, 71 submarines, 20 mine sweepers, 19 sea-going tugs, 35 harbor tugs, 12 oil tankers and 53 Ford eagles in various stages of completion.

MATÉRIEL

NAVAL BUILDING PROGRAM.—In advance of the return to Washington of the Secretary of the Navy and the bureau chiefs who accompanied him on his European trip of observation, the naval general board is giving its attention to the new naval building program. The failure of the 65th Congress to enact a naval appropriation bill with its authority for the construction of new ships of course necessitates the reconsideration of the measure and its provision for new construction when the 66th Congress shall meet in extra session. By that time it will be known to what extent the proposed league of nations will impose a limitation upon armaments. It may be expected

as a certainty that Congress will be promptly, if not eagerly, responsive to any suggestion contained in the league of nations covenant permitting the suspension of the building of fighting ships. It becomes a question at once, therefore, whether Congress will authorize the construction of more than the six battle cruisers which were authorized in 1916, and upon which construction, with the exception of the machinery, was suspended during the war to permit progress on the destroyers. It has been anticipated by the naval authorities that Congress would consent to additions to this number in view of the unquestioned value of the type in modern warfare. Then, it must be decided whether the ten battleships included in the program in the bill of the last session shall be battleships of the dreadnought type or the advanced type which approaches the battle cruiser. It is bound to be the occasion of an interesting discussion before the naval committees where, as usual, there is destined to be a difference of opinion among members encouraged, perhaps, as too frequently occurs, by failure to agree upon types and other details of design among the naval experts themselves. That, indeed, has always been one of the handicaps in the matter of obtaining prompt congressional approval of any departmental plan for naval fleet expansion. Naval committee members have been quick to take advantage of this situation and to insist, by way of defence for their inaction or procrastination, that they can hardly be expected to reach conclusions upon highly technical questions when the naval authorities carry their controversies on the subject to the Capitol for ventilation. The enlightenment of committees, which might be argued in justification of this proceeding, has the opposite effect frequently of providing an excuse for doing nothing. —*Army and Navy Register*, 4/5.

A FLEET FOR THE PACIFIC.—There will probably be during the next year a Pacific, as well as an Atlantic fleet; certainly, there will be a division of the present naval force between the two oceans or a division of time of one big fleet between the Atlantic and the west coast. If there are two commands of considerable dimensions, respectively, there will be an exchange of visits periodically and a program of joint maneuvers at least annually. The people on the west coast have been insistent upon this and the sentiment and desire have been growing with the increase in the number of the fighting vessels. Of course, nothing has been said during the war, when it was realized that the available ships were necessarily employed in the war zone or held in readiness for assignment to duty abroad. Now, with the cessation of hostilities, the request from the west coast is likely to be renewed in stronger terms than ever, especially as there is apprehension in that quarter of the unfriendly, or at least suspicious, activities of the Japanese. In that connection it is interesting to learn that the State Department has formally announced its intention to thoroughly investigate the persistent rumors of Japanese acquisition of a naval base in Southern California through some sort of secret treaty with the Mexican Government. Significance is imparted to the incident largely from the unusual circumstance of the official admission of the purpose of the State Department, since, ordinarily, such an action would be conducted with as little publicity as possible. However, with or without a Japanese "war scare," that usually makes its appearance about the time the naval appropriation bill is reported from committee, there will be a determination to have a formidable and permanent representation of naval power on the west coast, while the presence of Senator Poindexter of Washington, as chairman of the Senate naval committee in the 66th Congress, will be a direct and positive contribution to that end. For the first time in many years the west coast will have an important "say" in the deliberations of a naval committee of Congress and, as in the old days, New England, and more recently, southern influence has affected legislation, so it may be expected that west coast influence will do something more than hitherto for the navy yards on the Pacific coast and toward having a fleet in that ocean.—*Army and Navy Register*, 4/5.

PERSONNEL

GAIN IN NAVAL ENLISTMENTS.—First enlistments in the navy showed a marked gain during February. Although the shortest month there was a total of over 7000 recruits for the naval service. Of these, 5812 were made in this country, mainly at recruiting stations, as compared with 5007 during January, a net gain of 715. Over 400 of the men shipped in February had seen creditable service in the army or marine corps. As we have stated in these columns a large majority of recruits are youngsters, over 68 per cent of the newcomers in February being under 19 years of age. In addition to the recruits obtained in this country, a large force of ex-soldiers comprising the Philippine army were enlisted in the messman branch at Manila. The first 1000 were enlisted in a few days, and an excellent start has been made on the second thousand of the quota assigned the station. These Filipinos have had military training that will make them a valuable adjunct to the navy, and their services are in demand in the messman ratings throughout the fleet. The steady demobilization of the naval reserve force necessitates the enlistment of a considerable force of regulars within the next few months to meet the absolute requirements of the navy afloat, and even with the satisfactory gains made during the past month the navy promises to have a serious problem on its hands to fully man all the vessels which will await crews during the coming summer.—*Army and Navy Register*, 3/22.

NAVAL PERSONNEL SITUATION.—The naval authorities have been discussing the naval personnel situation in anticipation of Secretary Daniels' return from Europe when it is expected that he will consider the subject in its relation to the departmental recommendations to the 66th Congress. One of the subjects to be taken up at the beginning of the extra session, which must be called before July first, will be the naval appropriation bill, which failed of enactment in the 65th Congress. That measure will, of course, contain a provision for naval personnel, and it is believed that Mr. Daniels will renew the recommendations he made at the last session without material modification or amendment. He will be supported by the present chief of the Bureau of Navigation, Rear Admiral Victor Blue, in the view that an enlisted strength of 137,000 will be sufficient to meet the needs of the navy, especially with the transfer to the shipping board of the vessels used in the homeward transportation of soldiers from Europe and the release of personnel employed in that service. There was a difference of opinion and some lively exchange of sentiment among the naval authorities and the Secretary of the Navy in regard to the enlisted strength when that subject was before the naval committee of the late Congress. It is expected that there will be greater unanimity hereafter and that Congress will not authorize a strength of more than the departmental program in this particular. Nor will there be any radical change in the plan for providing a commissioned personnel. The sentiment in Congress will not be in favor of making special arrangements to this end, beyond the authority to absorb into the regular establishment 700 temporary and reserve officers for the line with a proportionate number for the staff; 500 officers of the flying corps, of whom 250 will be kept on flying duty and 250 will be prepared for line duty; and 300 of the older warrant officers with provisions for their promotion up to the grade of lieutenant commander. Then Secretary Daniels will renew his recommendation for an extension of the principle of promotion by selection to all grades of line and staff of the navy and marine corps, upon which proposal action was not taken by the House naval committee at the last session. At that time it was felt that promotion by selection was sufficiently in vogue and that there was doubtful wisdom in extending it. Mr. Daniels, however, is firmly convinced that the system is meritorious and, if extended, will be productive of the best results in personnel efficiency. He also believes that the ensign

at the end of the three-year period in that grade should be competitively examined for promotion to the grade of lieutenant, junior grade, leaving the latter grade the only one from which advancement to the next higher grade will be by seniority alone. There are, however, some objections to this proposed examination of the ensigns. It is pointed out, for one thing, that officers of this grade are apt, in many instances, not to have found themselves until later on in their career; on the other hand, it is insisted that the competitive examination will keep the ensigns keyed up to a standard of fitness which otherwise they may be prone to ignore. An additional objection, which is apt to have more influence, arises from the difficulty of conducting so many examinations as will be necessary in the course of a year in all parts of the world constituting an administrative situation that may be successfully urged against Mr. Daniels' plan in this particular.—*Army and Navy Register*, 4/5.

FIXING NUMBER OF NAVAL OFFICERS.—It need surprise no one in the navy or marine corps if a proposition is made in the naval committee of the next Congress to repeal existing law which provides for automatic increase in the number of commissioned officers of all grades and branches, and a return to the old method of maintaining a fixed number in each grade of line and staff, to be changed only by special authorization of Congress. There is objection expressed by some committee members to the system which bases the strength of commissioned personnel upon the number of enlisted men, despite what these critics admit is a plausible argument in its favor. It is evidently felt that advantage may be taken of this arrangement to create too many officers and to furnish special and extraordinary opportunities for adding to the number of commissioned officers. There is also a very well defined notion in the same quarter that the present sources of officers will be sufficient for the purpose of the service, considering the reserve personnel and the graduates of the Naval Academy. Indeed, there is a feeling that more should be done for the reservists in the way of promotion and in a provision for transfer to the permanent establishment. On the other hand, no such change is contemplated by the Navy Department and the proposition is not likely to receive the support of the Secretary of the Navy if he has an opportunity to pass upon it. It is certain to incur the opposition of the naval authorities, whose view in the matter is destined to have much weight with the conservative element in Congress.—*Army and Navy Register*, 4/5.

OPERATIONS.

SUBMARINE CHASERS ORDERED TO ALASKA FOR PATROL WORK.—Acting Secretary of the Navy Roosevelt authorizes the following:

Under the direction of the Navy Department a detachment of four submarine chasers has been ordered to Alaskan waters. The chasers will be accompanied by the gunboat *Vicksburg*, which will be the mother ship of the detachment, with two chasers operating at all times, two being held in reserve.

These vessels have been ordered to leave the navy yard, Puget Sound, about April 1, 1919, and to proceed to Juneau, Alaska, from which port they will operate until navigation closes.

Duty of Detachment.—This detachment will have on board fish wardens of the Department of Commerce, and have orders to cooperate with the officials of the Department of Commerce, the Treasury Department, and the Department of the Interior in enforcing law in Alaskan waters, rendering assistance to shipping and natives in distress.

The coast-guard cutters *Unalga* and *Bear*, operating under the direct orders of the commodore commandant, United States Coast Guard, pursuant to general instructions of the Navy Department, will also operate in Alaskan waters from about April 20 to October 1. The patrol by these coast-guard cutters is similar to that which has been maintained by the United States Coast Guard for several years past.—*Official Bulletin*, 3/24.

CAPTURED U-BOATS TO TOUR OUR PORTS.—Surrendered German submarines, now being brought to the United States by American naval crews, will be exhibited at ports on the Atlantic, Pacific and Gulf coasts, the Great Lakes and the Chesapeake Bay, and on the Mississippi and Hudson Rivers. The five submersibles will arrive at New York late this month, while the Victory Liberty Loan campaign is in progress.

The Navy Department announced to-day that after the fleet reached New York motion pictures would be made for display over the country, and that the submarines then would proceed on the following itineraries:

U-111, a submarine of the larger type, to Portland, Portsmouth, Boston, New Bedford, Newport, Providence, New Haven, and then lay up at New London.

U-117, a big ocean mine-layer, which planted mines on the Atlantic Coast during the war, will go to Philadelphia, Wilmington, Del., Wilmington, N. C., Norfolk, Baltimore, Annapolis, Charleston, S. C., and then lay up at Washington, D. C.

U B-88, a small type submarine, will proceed to Savannah, Jacksonville, Tampa, Pensacola, Mobile, New Orleans, thence up the Mississippi River to St. Louis, then to Galveston, Key West, through the Panama Canal, up the Puget Sound district, then lay up at San Pedro.

U B-148, a small type submarine, will be exhibited at various places in and about New York, then up the Hudson River as far as draft will safely permit, thence to Bridgeport and lay up at New London.

U C-97, a small mine-layer, will proceed from New York to Halifax, up the St. Lawrence River for exhibition at Great Lakes ports, and finally lay up at the Naval Training Station, Great Lakes.—*N. Y. Times*, 4/6.

MERCHANT MARINE

OFFICIAL PLAN FOR MERCHANT MARINE.*—The operation of a fleet representing 16,000,000 tons of ships, 70 per cent of which is owned by the government, is a problem that should be carefully considered from every angle, and in presenting this plan, I feel I should say that the government, without necessary delay, must take a prompt and definite step in giving legislative form to this, or some other policy which will meet with the approval of the country.

While the war was on, the recital of shipbuilding achievement found a quick and ready response from an enthusiastic public. There is less glamour and glory in the work of evolving a policy which will keep these ships under the American flag, and develop our commerce, but this work touches the life of the nation almost as closely as the emergency shipbuilding program.

I am personally opposed to government ownership, except as a last resort. During the war, it was necessary for the government to build a merchant fleet. Private capital never could have accomplished this colossal task, involving the creation of many new shipyards, and the training of a large army of workmen.

Government ownership of this large fleet resulted automatically. If we are to return to private ownership, the transition must be made under such conditions as will completely safeguard the interest of the public. If this fleet, built at government expense, were to be used now merely for the advantage of groups of ship-operators, with sufficient capital to purchase the ships from the government, I would unhesitatingly advocate the retention of the whole fleet by the government.

The problem is as complex as that of the railroad problem. Its solution is vital to the welfare and prosperity of the nation. Private ownership unquestionably offers an inducement to American energy and skill, but one

* From address delivered by Edward N. Hurley, Chairman U. S. Shipping Board, Thursday evening, March 27, 1919.

of the phases of unrestricted private control, which caused me considerable concern, was the possibility that under such control, ships would be overcapitalized as were many of the railroads. We want the initiative and skill of American ship-operators, but we want no watered stock. We want to avoid the stagnation that sometimes comes from red-tape and bureaucracy, but we want no profiteering nor exploiting.

We want the new fleet used for the benefit of the people of the United States and not against their larger interest. We want it used for the development of the nation's commerce, and not merely for the development of the private fortunes of ship-operators. No one will deny that our foreign trade, or the operation of American ships, will decline unless there is a profit for the men who invest their money, but whatever assistance the government is willing to render, should be reciprocated by those who are benefited. Therefore, the nation's shipping policy should certainly provide for such governmental representation as will guarantee a square deal to the public.

I think the whole nation is agreed that there must be no more scandals of overcapitalization in any part of American industrial or commercial life. The ships built by the nation should never be made the basis for any stock-jobbing scheme. The mere possession of large capital must not give the larger operator an opportunity to drive the smaller man out of business. In the plan I am ready to submit for the best thought and impartial discussion of the country, I believe you will find that the American theory of encouraging competition on fair terms is amply safeguarded.

In my judgment, any policy which does not encourage the building and the extensive operation of ships under the American flag will not satisfy the American people. I believe that a sound policy can be put into the form of legislation and that it will then form a permanent foundation for further improvements, as the need for them appears.

The United States Government now owns 555 ocean-going steel cargo ships aggregating 3,385,475 deadweight tons. In addition it has under contract 1336 similar vessels of 9,275,006 deadweight tons. If our present program be carried out, there will be under the American flag next year 16,732,700 deadweight tons of ocean-going steel cargo and passenger ships. This fleet will be the equivalent of almost half the merchant tonnage which plies the seas to-day under the flags of all nations combined. The government will own about 70 per cent of it.

The economic importance of this great fleet would be difficult to overestimate. Upon its successful operation under a sound financial and administrative plan by vigilant, courageous men who have the interest of American industry and commerce at heart, depends more than upon any other factor the future development of our overseas trade and of the domestic industries which feed it. With this brief review of the situation, I now submit this proposed plan of operation:

That the ships should be sold to and operated by American citizens under no restrictions other than the terms of the bill of sale and the fixation of maximum freight rates, either as provided in Section 18 of the Act approved September 7, 1916, or as may be agreed by the government and the operator in specific instances.

The ships should be sold at a price which fairly reflects the current world market for similar tonnage.

Twenty-five per cent of the purchase price of each ship should be paid down, the remainder falling due and payable in graded annual installments over a period not exceeding ten years. The government should take and hold a mortgage for the unpaid balance, charging interest thereon at the customary commercial rate of five per cent. One-fifth of this interest, representing the difference between the customary government interest of 4 per cent and the customary commercial rate, should be paid into a Merchant Marine Development Fund to be described hereafter.

The purchaser should be required to agree to insure and keep insured with an American marine insurance company, his equity in the vessel, and

because the American marine insurance market has not at present sufficient resources to underwrite all the vessels the government has to sell, the government should carry in its own fund, as at present, but for purchaser's account, hull and machinery insurance covering that part of the vessel for which payment has not been made. Our experience in operation shows that the government can carry this insurance for at least 1 per cent less than the open market rate. However, it is proposed that the open market rate be charged, and that the difference be paid into the Merchant Marine Development Fund.

It is understood that no transfer of a vessel to foreign registry should be permitted without express permission of the government.

Each purchaser who wishes to operate in the foreign trade should be obliged to incorporate under federal charter, the necessary legislation for which should be passed by Congress without delay. Such a charter should provide that no stock shall be issued in excess of the money value actually paid in on vessel property, and that no stock can be issued or transferred to an alien.

It should also provide that one member of the board of directors for each company shall be named by the government. This director should draw no salary, either from the steamship corporation or from the government. He should receive only the customary director's fee for each meeting he attends.

The same legislation should provide for periodical meetings of these government-named directors, in the city of Washington, where they will constitute an official body which will confer with and advise the Shipping Board, or other designated government agency, upon problems arising in, or questions affecting the welfare of, the American merchant marine, including the administration of the Merchant Marine Development Fund.

This fund drawn from the sources previously indicated, should be used to relieve such financial difficulties as may be encountered in the development of an adequate and well-balanced American merchant marine; for instance:

It is foreseen that a number of trade routes important to the immediate or future welfare of American commerce must be established and developed. Some of these routes may not yield steamship operating profits until their existence shall have attracted an increased volume or better balance of trade. Revenue derived from the carriage of mail, and possible fees for the training of seamen and cadet-officers, may partly compensate losses incurred on these routes. Still, in cases where the government sells a ship upon condition that it be operated in a route which may not prove profitable at once, it will be necessary to provide for the payment of defaulted interest from the Merchant Marine Development Fund, in the discretion of the Shipping Board or other government agency, upon recommendation of the board of government directors, until such time as the route may begin to yield profit. When the ships in the route earn their annual interest rate and a profit, one-half the profit earned each year should be paid into the Merchant Marine Development Fund until all moneys drawn from the fund on account of the vessel in question shall have been replaced. The other half should go annually to the steamship stockholders.

Such vessels cruising in routes which fail to prove susceptible of profitable development and which do not serve any purpose of the government of the United States, may be transferred by the government to other routes. However, should the government become convinced that any vessel has failed to make expenses solely or chiefly because of incapable management, it may foreclose its mortgage on that vessel.

On the basis of one billion dollars' worth of ships, the Merchant Marine Development Fund would be fifteen million dollars. This amount, investigation convinces me, would be more than sufficient to care for all deficiencies likely to develop during this period.

Until sold under the terms just stated, all vessels should remain the property of, and should be operated by, the government of the United States.

In order to make sure that the American merchant marine will be operated with due regard for the interests of American industry and commerce, it is necessary to exercise control over the maximum freight rates which may be charged in regular trade routes.

Sections 16 and 17 of the Act approved September 7, 1916, provide remedies for unjust discrimination by American shipowners against any American shipper or port, and they also forbid the collection by common carriers in foreign commerce of any rate unjustly prejudicial to American exporters as compared with foreign exporters. Section 18 of the same act authorizes the fixation of maximum freight rates charged by common carriers by water in interstate commerce.

There remains to be provided means for preventing the impartial imposition of unjustly high rates upon all commerce moving into or out of the United States. This is manifestly beyond the power of legislation at the moment, and it is proposed to secure such control by agreement inserted in the bill of sale under which the ships are released, and by making such control a condition of participating in the benefit of the Merchant Marine Development Fund.

THE NECESSARY RELATION BETWEEN THE MERCHANT MARINE AND THE NAVY.—During the war I have been brought into close contact with many officers formerly of the merchant marine, but who are now enrolled in the navy—I have learned much from them, and my association with them, and my inspections of the ships which they command have impressed me not only with the desirability of a common plane upon which the navy and the merchant marine can work, but also of its practicability. Indeed, I regard it as essential to the efficiency and permanency of the merchant marine.

The year 1917 was, so far as our merchant marine is concerned, *annus mirabilis*. Then it was we commandeered about 400 foreign vessels building in our shipyards, and ordered a total of 2000 vessels to be rushed to completion; it did not need any high-brow demonstration to show that this country required ships, plenty of them, and just as quickly as we could get them. We were going to send an army of 2,000,000 soldiers beyond the seas, and every man required five tons of shipping. This was the rebirth of our merchant marine.

And now the problem is how to assure the healthy development of this infant. It would appear neither wise nor expedient to attempt to place our new merchant marine exclusively either under the government or under private control. For the time being at least, a combination of these controls would appear necessary. In framing a policy we must watch closely the methods of foreign governments. It is manifest that our shipping industry must be backed by our government and that our navigation laws must be changed to the extent necessary to assure competition with foreign shipping on a basis of parity. At the same time, in order to hasten the stabilization of trade conditions private enterprise should be encouraged to enter the shipping business at once, and as things settle down to take over step by step a larger share of the management.

We must adopt the point of view that a large and sufficient merchant marine is an absolute necessity for our national prosperity and possibly for our national existence.

I would suggest as a connecting link between the merchant marine and the navy it might be well to retain a few lines of fast mail steamers manned by a regularly enlisted auxiliary naval personnel. These steamers to be so constructed and their crews so drilled that in an emergency they would be immediately available for war service as scout cruisers. Whatever the details of policy finally decided upon, in any event, it is certain that the

navy and the merchant marine must remain closely related. The experience of the war has driven home the essential value of a prosperous merchant marine as a national naval reserve.—*From Address by Vice-Admiral Gleaves, 3/27.*

AMERICA RAPIDLY REGAINING HER PLACE AS LEADER OF WORLD'S MERCHANT MARINE.—The Shipping Board issues the following:

At the opening of the European war the very little seagoing tonnage operating under the American flag carried only 9.7 per cent of the exports and imports of this country. To-day the American merchant marine comprises 46 per cent of shipping plying between our own and foreign ports. Moreover, this new and rapidly increasing fleet now represents nearly one-fifth of the entire seagoing tonnage of the world.

Although a very large number of our ships are still absorbed by army and navy needs, there being on January 31 a total of 302 vessels diverted to army requirements and 51 to the navy, yet we had enough shipping left to make an important showing in overseas commerce. Tables prepared by the Shipping Board's Division of Planning and Statistics show that on January 31 there were employed in overseas service under the American flag a total of 752 vessels, aggregating 1,961,239 gross tons.

This fleet includes 351 freighters, 84 freight and passenger vessels, three freight and refrigerator vessels, seven freight, passenger, and refrigerator ships, six colliers, 71 steam tankers, and 230 sailing vessels.

When the army and navy return to the Shipping Board the 353 ships which they are now operating, the commercial fleet under the American flag will be augmented by 1,873,521 gross tons, equivalent to 2,434,017 dead-weight tons.—*Official Bulletin, 3/11.*

NAVIGATION AND RADIO

THE WIRELESS COMPASS.—A coil of wire, a dial registering 360 degrees, a hollow steel shaft, and an automobile steering wheel have overcome the terrors of fog and storm to mariners approaching port. These few pieces of apparatus comprise the essential parts of the radio compass, an instrument whereby the bearing of any ship on a shore station may be ascertained with speed and accuracy.

In construction, the radio compass differs from the usual radio receiving set mainly in the type of antennæ used. The familiar sight of several strands of wire stretched at considerable length between high masts is absent. In place of the stationary, space-consuming aerial, is a rotating 5-foot frame with a few turns of stranded copper-bronze wire wound about it. The frame is mounted on a vertical steel shaft which projects downward through the roof of the radio building into the room where the operator is on watch. In many stations, a cupola has been built about the frame with the double purpose of affording protection against the elements and of concealing its presence. At the base of the shaft, and within easy reach of the operator, the wheel which controls the turning of the frame is attached. The compass dial, usually a circular aluminum band, with the 360 degrees of the compass clearly engraved on its surface, is fastened to the shaft near the roof of the radio "shack"; but the indicator is placed in a permanent north and south direction. Two "leads" from the frame form the electrical path between the antennæ and the receiving set.

In conjunction with the receiver, an oscillating audion and an amplifier are usually employed thereby magnifying the strength of incoming signals about eight times their normal degree of audibility.

The theory on which this unique construction of the radio compass operates involves several characteristics of the electro-magnetic wave. If a pure sine wave (which is never met with in practice because of the distorting influence of objects in and around the radio room), is assumed, three phenomena of electricity combine to give the results observed in the radio compass. They are the resisting or "bucking" action of induced

currents, and the differences in amplitude and in phase of an electro-magnetic wave at different intervals of time. Two electric currents are induced in the antenna, the one when the magnetic wave comes in contact with the nearer side of the arial, the other when it reaches the farther side. These induced currents will be in the same direction, and consequently will tend to "buck" or counteract each other. But, due to the differences in amplitude and in phase of the magnetic wave at the two points of contact, the induced currents will be of different strengths; and, although the one tends to obliterate the other, the difference in strength between them is conserved and heard in the telephones. However, if an incoming electro-magnetic wave strikes the plane of the antenna perpendicularly, the currents induced in both sides of the compass will be equal in strength, of the same phase and amplitude, and will neutralize each other. No sound is then heard in the telephones. By means of the rotating antennæ, the angle at which an electro-magnetic wave acts on it can be controlled by the operator. Thus the intensity of an oncoming signal can be increased, diminished or completely tuned out by a turn of the wheel. It is evident, then, that when the plane of the antennæ is parallel to the direction of the oncoming wave, the sound heard in the phones will represent the maximum strength of the oncoming wave. By turning the antennæ until this point is found, the maximum strength of any signal can be ascertained; and consequently, the position of the ship or shore station sending it will be disclosed. But to be more accurate, two positions are made known, 180 degrees apart. By consulting the diagram, the reason for this is apparent. It will be observed that two waves coming from opposite directions will affect the radio compass in the same manner.

In actual practice, however, a shore station operator knows that the coast line limits the arc of the compass in which he may expect to locate a ship. Moreover, to secure the best possible results in the every-day operation of the radio compass in guiding vessels into the port of New York, five radio compass stations have been established at strategic nautical points on the coast near New York. Each station is connected by a land line telegraph instrument with a central controlling radio station located in the office of the District Communication Superintendent, at 44 Whitehall St.

The close connection between the compass stations and the control station simplifies the details of communication with vessels at sea. Within a few minutes a ship may receive definite information as to its position. When a ship approaches the 50 or 100-mile coast line, the operator abroad calls New York and asks for his bearing. The ship does not get into direct communication with the various compass stations as they are equipped only with receiving sets, and so cannot reply. However, the radio operator at the central controlling station, in answering the ship's call, transmits a signal to the ship to send its call letters for 30 seconds. At the same time, a telegraph operator at the control station notifies the various compass stations, by means of a three letter signal sent simultaneously, to obtain a bearing on the ship sending her call letters. Immediately the various stations in the district, at Montauk Point, L. I., Fire Island, L. I., Rockaway Beach, L. I., Sandy Hook, N. J., and Mantoloking, N. J., turn their compass wheels until an accurate bearing is obtained at each station. This is transmitted to the telegraph operator at the control station, who waits until all stations have sent their bearings before turning them over to the radio operator. The latter, when all the compass stations have been heard from, flashes by radio the bearing, in degrees, of the ship on the different shore stations. An acknowledgment from the ship of the receipt of the desired information completes the operation.

The accuracy of the bearing reported by each compass station is determined at the control station by consulting a map of the coast which is arranged with an ingenious device for the particular purpose it serves. The map, spread out on a large table, is covered with glass. Holes are punctured through the glass at the center of the large circles drawn about the various

compass stations as centers. The circumferences of the circles are divided into degrees. Threads are then led through the holes and laid out on the map. When a compass station sends a bearing to the control station, the operator there draws out a thread to mark the line of direction between the ship and the compass station. As the other bearings are reported, similar marks are laid down; and the point where all the threads intersect is the exact position of the vessel desiring to know its position. Sometimes all the bearings reported do not intersect when diagrammed on the map with black thread. Then the space enclosed by the various intersecting points designates the area in which the ship may be located.

In the immediate future every American port will be safeguarded by a system of radio compasses and control stations. Then, at any point along the coast, mariners will be enabled to check up bearings obtained in the old way, and need never fear missing the channel on a foggy night or in a rough sea.

From an article by Jerome Lachenbruch, Radio Electrician, U. S. N. R. F. —*Scientific American*, 3/22.

NAVIGATION AND RADIO

The wireless telephone messages between New Brunswick, N. J., and the steamship *George Washington* at Brest, France, covered a distance of approximately 3200 miles, the greatest distance yet covered by the wireless telephone by several hundred miles, B. F. W. Alexanderson stated to-day. He began experimenting for the General Electric Company at New Brunswick about two years ago, but before much progress could be made the government took over the plant for wireless telegraph communication with France. When the President decided to go abroad the experiments were resumed and the apparatus brought to its present state.

Mr. Alexanderson believes that commercial wireless telephone service will soon be established between all the principal cities of the world. The features of his invention making long-distance telephoning possible are, according to Mr. Alexanderson, his high frequency alternator, known as the Alexanderson alternator, which provides a more efficient way of generating electric waves, and his new magnetic amplifier, which transforms telephone currents to high-power electric waves. He also has a new antenna which is several times more efficient that any previously used.—*N. Y. Times*, 3/21.

RADIO TELEPHONY.—*First Field Trials of Radio Telephony.*—In 1914 it was decided that the apparatus and methods developed in the laboratory were sufficiently promising to warrant an attempt at transatlantic telephony.

In order that a practical demonstration of the method might be obtained an experimental station was constructed at Montauk, L. I., and a receiving station was constructed on the roof of the Dupont Building, in Wilmington, Del. A trial was made on April 4, 1915, in the presence of Professor Millikan and Colonel Reber, as well as Messrs. Carty, Gherardi, Jewett and others of the executives of the engineering departments of the American Telephone and Telegraph and the Western Electric Companies. The transmission was, of course, one way only. These gentlemen, therefore, witnessed the operation of the transmitting equipment at Montauk on one day and then on the following day visited the receiving station at Wilmington and listened to the incoming transmission. Wire connections between Montauk and Wilmington permitted the listeners at Wilmington to report immediately what words they had heard, or, as on the second day, it permitted the speaker at Montauk to report what he had said. The wire connection thus admitted of the verification of the experiment.

Following this demonstration the range was extended from Montauk to St. Simons Island off the coast of Georgia where a receiving antenna had been erected. For the purpose of this experiment the radio receiving circuit

at St. Simons was connected to a telephone circuit leading to New York. Similarly, the radio transmitting equipment at Montauk was connected to a telephone line leading from New York. The speaker at New York talked over a wire circuit to Montauk, by wireless to St. Simons and then by wire to a listener in New York.

The method which was used in transmission was essentially that which was followed in later experiments when the navy station at Arlington was used as a transmitting station. Prior to this time the inability of inventors to modulate large amounts of power in such a manner that the modulated current, when detected at the receiving station, could be obtained essentially free from distortion, had proven a serious limitation on the increase of range of transmission. It had been shown, however, that this limitation could be overcome by the use of the audion amplifier and modulator. The general method proposed, therefore, and the method finally developed was as follows: A small current of high-frequency was to be generated by means of a vacuum tube oscillator. This high-frequency current was to be modulated, essentially completely, by the voice current from the telephone transmitter. The resulting modulated current was to be amplified, or successively amplified, by distortionless amplifiers, of the vacuum tube type, until the energy which it represented was sufficient for transmission from an antenna over the desired distance.

For the production of a sustained high-frequency current a vacuum tube was used. With such a tube, provided its input and output circuits are coupled together and one of them contains a tuned circuit, the operation is one of successively amplifying its own output. This successive amplification will result after a moment in the development of a steady state of oscillation in which there is a definite maximum of output current. This maximum amplitude of the generated alternating current depends for its value upon the characteristics of the tube itself.

As noted above, the study of the vacuum tube had also indicated that although it was possible to use the tube as a distortionless amplifier, it was also possible to adjust its voltages and the impedances to which it was connected so as to produce a distortion of the input current in a manner suitable for the purposes of radio telephony. Under such conditions the output of the tube contains a component which is proportional to the product of such voltages as may be simultaneously impressed upon its input or grid-filament circuit. If one of these inputs is obtained from the oscillation generator just described and the other from a telephone transmitter, it is then possible to obtain an output which varies harmonically with the frequency of the oscillation generator, and also varies harmonically in amplitude with the frequency of the voice current impressed by the transmitter.

A vacuum tube, properly designed for the impedances between which it was to be connected and properly adjusted so as to emphasize the modulator characteristics, was used as a modulator in the system of transmission which was formally demonstrated at Montauk. To its input was coupled inductively the tuned circuit of the oscillation generator and also telephone transmitter circuit containing a local battery.

In order to obtain a sufficient amount of energy for transmission over appreciable distances, it is necessary to amplify the energy output of the modulator before impressing it upon the antenna. In case considerable amplification is desired it may be obtained by impressing the voltage from the modulator upon an amplifying system formed by two amplifiers in tandem. It was also realized that amplifiers might be worked in parallel, that is, with their input circuits connected in parallel and with their output circuits connected in parallel, without introducing disturbing interactions, provided that certain precautions are taken. The method of amplification adopted for the Montauk tests and later used for the Arlington experiment was therefore a system of two stages of the amplification. At Montauk the first stage was obtained by a single tube and the second stage by a number of tubes in parallel.

The Arlington-Darien Experiment.—The tests from Montauk to Wilmington and to St. Simons Island were so successful that it appeared practicable to carry the method to its logical conclusion and to extend the range of radio telephony to much greater distances. For this purpose experiments were undertaken in conjunction with the Navy Department. For the initial steps in making such arrangements and for assistance throughout the experiments, we are indebted and distinctly grateful to Admiral R. S. Griffin, Engineer in Chief, U. S. Navy, Captain now Admiral W. H. G. Bullard, Superintendent of the Radio Service, and to Commander now Captain Hepburn and Lieutenant now Commander C. S. Hooper of the Bureau of Steam Engineering, U. S. Navy.

For the purpose of these experiments a small operating house was constructed beside the main operating building of the Navy Wireless Station at Arlington, Va. An antenna switch was provided so that the antenna might be connected to the Western Electric equipment in this experimental station. Captain Bullard also arranged for observers from the Western Electric Company to be present at the navy stations at Darien, San Diego and Mare Island. The necessary apparatus was installed in the early summer of 1915 and preliminary experiments were started at once. On August 27 successful transmission was obtained to Darien on the Isthmus and was received by Mr. R. H. Wilson of the Western Electric Company and by Lieutenant R. S. Crenshaw of the navy.

On this day Colonel Reber, Lieutenant Bryant of Captain Bullard's office and Mr. G. H. Clark, radio expert of the Bureau of Steam Engineering, had been asked to speak from Arlington in the hope that communication would be established with Darien. Immediately prior to the time these gentlemen spoke, two selections were played on a phonograph placed in front of the telephone transmitter. These were correctly recognized by Wilson and Lieutenant Crenshaw. Each of the visitors then spoke for a minute or two. The voices of the speakers were not familiar to the observers at Darien. Wilson, however, recognized the change in voice caused by a change in speaker and received correctly several phrases and some scattered words. These words were also verified by Lieutenant Crenshaw. A report of these results was sent immediately from Darien by navy code to Arlington and was compared by the speakers with their records of their spoken words.

The method of transmission was essentially that described above in connection with the Montauk experiment. The transmitters used in these tests were of the ordinary commercial type, or of a type which was then in a stage of development and which it was thought might reproduce more exactly some of the higher harmonies of the voice. A phonograph was also used for the transmission of music. The output of the transmitter was amplified in a speech amplifier of the audion type. The output of this speech amplifier and of the high-frequency oscillator were both impressed upon a modulator of the vacuum tube type. The voltage of this amplifier was not, however, high enough for the main amplifying tubes, and it was stepped up by an intermediate group of amplifiers, of which six as a rule were used. The modulator output thus amplified was impressed upon a number of power tubes in parallel and then upon the antenna transformer. The amplifier tubes preceding the power tube and the modulator were also of the same form, but were of different constants, properly adapted to their purposes.

The current by which the filaments were heated was supplied by a local power company and brought in by underground cable to the operating station. Alternating current was used for heating the filament and any possibility of the superposition of a 60 or 120 cycle note, due to the frequency of this current, was eliminated by the use of a special scheme of connections. Between the plate and the filament of the power tube a constant voltage of about 500 volts was impressed. It was obtained from one of the motor generators used by the navy in operating the large Poulsen

arc, with which they were then transmitting to Darien and other remote points. A large amount of energy, of course had to be dissipated in such an equipment because of the energy supplied to the filaments, and a blower was installed for this purpose.

The method of reception was varied from time to time as it was still in process of development. In some cases an amplifier for the high-frequency currents was introduced between the detector and the tuned circuit which was coupled to the antenna. In some cases a low-frequency amplifier was inserted between the detector and the receivers. In some of the later experiments a feed back circuit was used for the detector so that the detector tube itself acted as an oscillation generator as well as a detector. In that case the frequency of the oscillations was adjusted to be the same as those of the oscillation generator at the transmitting station.

The New York-Arlington-Mare Island Demonstration.—After obtaining successful communication with Darien, a distance of 2100 miles, attention was directed towards reaching the Pacific Coast stations of Mare Island and San Diego. As a test of the transmission efficiency, records were made at the W. E. Co.'s laboratory in New York of the quality and intensity of the speech from Arlington, each time transmission was attempted. Records were also made occasionally at Darien, but no attempt was made to fit the time of transmission into the schedule of operation of that station. An order wire was set up between Arlington and the two Pacific Coast stations, so that instructions as to the schedule of tests and reports as to its results might be conveniently interchanged.

Radio telephone transmission between Arlington and Mare Island was formally demonstrated on September 29. On this date, Mr. J. J. Carty was inspecting the station at Mare Island. A demonstration for Mr. T. N. Vail was therefore arranged for this date.

The station at Mare Island consisted of a small house near enough to the operating house of the navy so that the experimental apparatus might be connected to the antenna. The observers at the Mare Island station were Commander G. C. Sweet and Lieutenant Kenshit of the navy, Mr. A. H. Babcock, consulting engineering Southern Pacific Railroad, Mr. J. J. Carty and others. Messrs. Arnold and Hartley of the Western Electric Company were the experimenters.

Arrangements had been made whereby Mr. Vail's apartment in New York could be connected with the radio apparatus at Washington. A telephone line extended from the transmitter assigned to Mr. Vail's use to the radio telephone apparatus at Arlington. This telephone circuit was connected to the radio apparatus in place of the telephone transmitter which had formerly been used at Arlington. From Arlington transmission was through the ether to Mare Island. The telephone set which Mr. Carty used at Mare Island consisted of a transmitter connected to a telephone line leading, via the New York test Board, to a receiver in Mr. Vail's apartment. The receiver of Mr. Carty's set at Mare Island was one of several which were supplied in parallel by the detector of the radio receiving set. Arrangements were thus made whereby Mr. Vail and Mr. Carty might carry on two-way conversation, but what Mr. Carty and the other observers heard at Mare Island was transmitted from Arlington by wireless.

At the New York toll test board a telephone line was bridged onto the circuit leading from Mr. Carty to Mr. Vail. This line extended to Arlington and contained one-way repeaters so that transmission could take place only from New York to Arlington. At the latter place it supplied a group of telephone receivers which were also connected through a one-way telephone repeater with the line which bore Mr. Vail's speech to the radio apparatus. In this way some dozen observers at Arlington could hear both sides of this unique conversation. The use of one-way repeaters prevented any interaction between the oppositely directed speeches.

At the Arlington station the conversation was listened to by Captain Bullard, Colonel Reber, Commander Hooper, Lieutenant R. B. Coffman,

Lieutenant Bastedo, Commander Bryant, and members of the telephone system. Messrs. T. N. Vail, U. N. Bethel, J. I. Waterbury, Bancroft Gherardi, and H. P. Charlesworth all conversed with Mr. Carty through the ether.

The Arlington-Honolulu Experiment.—Having successfully transmitted over water to Darien, a distance of 2100 miles and over land to Mare Island, a distance of 2500 miles, attention was now directed towards reaching the remoter points of Honolulu and Paris. Schedules were therefore arranged for experiments with these stations. With Paris, however, the arrangements as to schedules were necessarily delayed because of the difficulties in cable transmission occasioned by the war.

With Honolulu, on the other hand, arrangements for a transmitting schedule had been made shortly before the demonstration of the New York-Arlington-Mare Island transmission. The first deliberate attempt to communicate with this station occurred on the night following the demonstration to Mare Island. Mr. Lloyd Espenschied of the American Telephone and Telegraph Company, who was the experimenter at this point, reported by cable the following morning, giving a record of the words which he had heard spoken, and also the name of the speaker, whose voice he had recognized.

The Arlington-Paris Experiment.—At Paris where Mr. Shreeve and Mr. Curtis of the Western Electric Company, in which connection it may be mentioned that they are again in France, the former as lieutenant colonel and the latter as lieutenant in the signal corps. These experimenters had installed their apparatus in the Eiffel Tower station of the French Army. This courtesy had been accorded our representatives by Lieutenant Colonel Ferrié, Director of the Military System of Radio Telegraphy, to whom they had been introduced by Commander W. R. Sayles, Naval Attaché of the American Embassy. The magnificent spirit which France has shown throughout this bitter struggle is well illustrated by the ability of that nation to consider scientific developments, which apparently were not of immediate military value, and to assist in them despite the demands of the war. The amount of time during which our experimenters could use the antenna was, of course, very limited, and was small as compared to their necessities. The permission to use the antenna at a time when France was wholly engaged in this bitter struggle represents a contribution to science altogether disproportionate to the time which the antenna was available to our men. Unfortunately, however, much of the time when Mr. Shreeve and Mr. Curtis had access to the Eiffel Tower antenna there was interference from other high power stations on the Continent, such as Nauen, Eilvese, Clifden, Norddeich, Lyons and Vienna which were transmitting upon the same range of wave lengths as it was necessary for us to employ. Instructions from Paris to Arlington, to alter the wave length of the transmission, could be forwarded only by cable, and were, of course, subject to days of delay, so that a satisfactory and flexible working schedule was not to be hoped for. Further, it was possible to transmit in any one day only for a brief period. In spite of these difficulties, promising results in the way of clearly received speech at Paris were secured during short periods that it was possible to arrange for working between October 12 and October 21. On October 23 as a final demonstration a number of observers, including Commander Sayles and representatives of the French Army, listened to the telephone transmission from the Arlington station 3600 miles away. The wave length used was about 6000 meters and the antenna current at Arlington about 50 amperes.

On certain of the occasions when we had worked to Paris, Mr. Espenschied at Honolulu had been informed as to the schedule of tests. He had therefore listened in and copied the words spoken at Arlington. The conditions at his stations were, of course, much better than at Paris because of the absence of interference from high power stations in the neighborhood. His observations were upon transmission over a distance some

25 per cent greater than that from Arlington to Paris, and in part over land as well as sea water.

Practical Developments.—The impending danger of war put an end to the experiments as far as they were concerned with increase in range of transmission. The possibility of applying the principles which had been successfully developed in connection with these experiments in trans-Atlantic and trans-Pacific radio telephony to problems of immediate and patriotic value was of course evident. Subsequent developments and experimental tests were therefore directed solely with an aim toward their military value to the army and the navy. Some of these experimental developments which we made in this connection and the success with which they were accompanied may be of interest.

The first opportunity to demonstrate the use of the wireless telephone in war was presented early in 1916. Secretary Daniels desired a demonstration of what could be accomplished in the way of mobilizing the telegraph and telephone facilities of the country in case of war-time need. This was carried out by the American Telephone and Telegraph Company in May, 1916, and included as part of it wireless telephone communication with a battleship at sea.

The part played by the wireless telephone was to show the possibilities of quick communication by word of mouth between vessels at sea and headquarters on land. A complete set was built and installed on the battleship *New Hampshire*. The transmitting to the battleship was done from our station at Arlington. The signals from the battleship were received at the navy yard at Norfolk with a set built for that purpose, and were automatically transferred to land telephone lines to Washington. The connections were brought directly to the mobilization switchboard at the Navy Department Annex. When it was desired to talk to the battleship, the regular telephone circuit from the Navy Department was connected up with the lines to Arlington and Norfolk, thus allowing communication by telephone to be held directly with the captain of the vessel. It was found entirely practicable to hold two-way radio communication as effectively as over wire lines and to secure information or to give orders. Captain Chandler received his orders for maneuvering in this experiment by wireless telephone from Secretary Daniels and Admiral Benson, and he reported to them each hour his position by the same means. The fact that the lines to the transmitting and receiving land stations came to Washington where these gentlemen were located did not mean that such an arrangement only was possible. The radio system was attached to the long distance telephone line and Captain Chandler talked with Lieutenant Snyder of the Great Lakes Naval Station. It was then connected with the Transcontinental Telephone Line and he talked directly with Captain F. M. Bennett, Commandant of the Mare Island Navy Yard. The ship during these conversations was 50 miles from Norfolk and outside the Capes.

The set installed on the *New Hampshire* differed from the set at Arlington only in size. The general circuit arrangement and modulation system was the same. The set was installed on the lower bridge deck and the telephone transmitter and receiver were installed on the bridge itself. This allowed the captain, while on the bridge and directing the movement of the ship, to converse without leaving his post.—Paper by E. B. Craft and E. H. Colpitts presented before A. I. E. E.

ENGINEERING

INTERNAL-COMBUSTION ENGINEERING.—*Performance of Marine Diesel Engines.*—Tests of Merchant-Ship-Type Diesel Engines.—Data of official trials of two 1200-i. h. p. (750-b. h. p.) Diesel engines built by J. Samuel White & Co. for the British Admiralty. The trials were carried out in

accordance with the special requirements of the British naval authorities and in the presence of their representatives.

The engines are direct reversible, two-cycle, single-acting, stepped-piston type, 6-cylinder, 14½-inch bore by 24-inch stroke, and have a weight complete of 70¼ long tons.

The trials of the first engine consisted of 96 hours of uninterrupted running at the full load of 750 b. h. p. at a speed of about 200 r. p. m.

During the whole trial the engine ran satisfactorily without any stoppage and without any sign of overheating either in the cooling system or working parts. The exhaust was quite invisible and very little soot was observed after the completion of the trial. The temperatures at the end of the trial were practically the same as those attained at the end of the first hour.

The circulating water was passed through the engine by steam pumps, the quantity per brake horsepower being approximately 11.2 gal.

Additional maneuvering trials were carried out with the port engine consisting of astern running, time taken to pump up the starting reservoirs, slow-speed running and the drop in pressure of the starting air after each start.

Table 1 is representative of the results obtained in the 96-hour trial of the starboard engine, while Table 2 gives data on lubrication and also the heat balance of the engine. (*Motorship*, vol. 4, no. 3, March, 1919, pp. 17-20, illustrated, *eA.*)

TABLE 1.—DATA ON 96-HOUR TRIAL OF STARBOARD ENGINE

Mean b. h. p.	751.8
Mean r. p. m.	190.5
Mean i. h. p.	1215.6
Mechanical efficiency, per cent	61.84
Total revolutions for 96 hr.	1,097,307
Total lb. of fuel oil used during 96 hr.	35,205
Fuel per b. h. p. per hr., lb.	0.487
Total lubricating and cooling oil used for 96 hr., lb.	887.7
Mean lubricating and cooling oil per b. h. p. per hr., lb	0.0123
Mean temperature of cooling water, inlet, deg. fahr.	61.5
Mean temperature of cooling water, outlet, deg. fahr.	99.5
Mean temperature of piston oil cooling, inlet, deg. fahr.	90
Mean temperature of piston oil cooling, outlet, deg. fahr.	125
Atmospheric temperature of test shop, deg. fahr.	61.5
Injection air pressure (mean), lb. per sq. in.	1000
Scavenge air pressure (mean), lb. per sq. in.	7
Air Compressors:	
I.P. air cooler pressure (mean), lb. per sq. in.	127
L.P. air cooler pressure (mean), lb. per sq. in.	27
Circulating cooling water pressure (mean), lb. per sq. in.	5
Piston cooling and lubricating oil pressure (mean), lb. per sq. in.	61.56
Compressor suction open, per cent of total	5.35
Mean indicated pressure of No. 1 cylinder, lb. per sq. in.	110
Mean indicated pressure of No. 2 cylinder, lb. per sq. in.	106.7
Mean indicated pressure of No. 3 cylinder, lb. per sq. in.	108.4
Mean indicated pressure of No. 4 cylinder, lb. per sq. in.	103.4
Mean indicated pressure of No. 5 cylinder, lb. per sq. in.	117.0
Mean indicated pressure of No. 6 cylinder, lb. per sq. in.	102.5
Blast air used per b.h.p. = 0.22 cu. ft.	

TABLE 2.—DATA ON LUBRICATION—HEAT BALANCE OF ENGINE

	Lb.	Oz.
Oil for power and scavenge pistons and L. P. compressor pistons	80	0
Oil for crankshaft and valve gearing	112	0
Oil for piston cooling and bearing lubrication	693	0
Total	885	0

(*i. e.*, 0.22 lb. per hour or 0.0123 lb. per b.h.p. per hr.)

HEAT BALANCE

Calorific value of fuel, B.t.u. per lb.	19,510
Consumption per b.h.p. per hr., lb.	0.487
Consumption per i.h.p. per hr., lb.	0.303
b.h.p. = 751.8, i.h.p. = 1215.6 } Mech. efficiency, per cent	61.84

$$1 \text{ b.h.p.-hour} = \frac{33{,}000 \times 60}{778} = 2550 \text{ B.t.u.}$$

1 b.h.p. requires 1.62 i.h.p., therefore frictional

$$\text{Heat per b.h.p} = \frac{0.627 \times 33{,}000}{778} \times 60 = 1578 \text{ B.t.u.}$$

Heat taken in per b.h.p. per hr. = $19{,}510 \times 0.487 = 9500$ B. t. u.

$$\text{i.h.p. heat units per b.h.p.} = \frac{1.62 \times 33{,}000}{778} \times 60 = 4120 \text{ B.t.u.}$$

	B. t. u.	Per cent	
Heat converted into work on brake	2550	26.9	43.5 per cent
Heat lost in engine friction	1578	16.6	
Heat converted into indicated work	4120	43.5	100 per cent
Heat lost in cooling water	2480	26.1	
Heat lost in exhaust gases	2900	30.4	
Heat taken in per b.h.p. per hour	9500	100.0	

Thermal efficiency of engine = 26.0 per cent

—*Mechanical Engineering*, 4/19,

ARC WELDING IN THE BUILDING AND REPAIR OF SHIPS.—By Robert G. Skerrett.—The seedless orange has ceased to be a marvel, but the rivetless ship is coming to amaze us, instead. True, the rivetless ship is not yet quite an accomplished fact, but it is measurably near. According to technicists, we may confidently count ere long upon steel craft securely bound together with no more than 20 per cent of their accustomed rivets in place—electric welding will do the rest of the fabricational work!

Offhand, this sounds little short of a veritable revolution in shipbuilding practice, and yet it is the logical climax of some years of successful work in metallurgical undertakings in which steel parts of a wide variety have been welded securely together both by oxyacetylene gas and by means of electricity. In large measure, however, the pressure of war and the compelling urge of a greatly stimulated building of ships to offset the toll of the submarine have speeded up an ever-widening recourse to electric welding in naval architecture. Technicists, far and wide, were fully alive to the time and labor involved in driving rivets, and quite naturally they asked: "Why can't we do away with these binding units and substitute the unionizing heat of the torch or the electric arc?"

Probably the most convincing answer to this query, gauged by extent and the scale of the departure, is the case of the English "cross-Channel" barge built at Richborough, England, and launched about the middle of last year. The craft in question, the *Ac 1320*, has an over-all length of 125 feet between perpendiculars, a breadth of 16 feet, and a displacement of 225 tons. She represents a good-sized experiment; and her design was purposely simplified in order to facilitate the employment of electric welding. That is to

say, her cross-section throughout the greater part of her length is rectangular, having only her bilge plates curved. Because of this, it was comparatively easy to erect the structure and to get her plates in position preliminary to welding. To hold them in place, *pro tem*, only a few bolt holes were needed; and after the lapped joints of the shell were welded the bolts were withdrawn, and the holes plugged with pins, which were, in their turn, sealed fast by the arc. The *Ac 1320* has met the stresses of service in an excellent manner and has had to contend with rough weather.

The hull plates of this novel vessel are lapped and the edges joggled, and this arrangement greatly aided horizontal downward welding. That is to say, the process of binding the contiguous surfaces together involved feeding molten steel into the upturned seam or lap. It was, in short, a sort of soldering process. Captain James Caldwell, of the Royal Engineers, has made it clear that there is a distinct economic gain to be realized in recourse to electric welding, but it is equally plain that the operator must be something of a specialist—probably more so than his corresponding rival who handles a rivet gun. This authority informs us:

"The operators were first-rate men, with extensive experience of electric welding in the shops and on structural work in shipyards. With the most difficult welding, such as vertical joints and overhead work, the quality of the welds was excellent. Quasi-arc electrodes were employed throughout, and for overhead work a special electrode was used. This proved well worth the slightly increased cost. All watertight joints up to and including the underside of the bilge plates were continuously welded both inside and outside, and the other watertight joints were welded continuously on one side and tack welded on the other. On the shell plating, the continuous welding was on the outside in all cases. For internal non-watertight joints and frame construction, tack welding was adopted sufficient to give a margin of strength over a similar riveted joint.

"Some interesting details are provided of the comparative cost of the electric welded and the riveted barges. In labor, 245-man hours were saved in constructing the welded barge. More than 1000 pounds of metal was saved by the substitution of welding for riveting, and even greater economy will result when the design is further modified to suit electric-welded ship construction. There were altogether 7000 lineal feet of welding on the barge, and over 3000 holes had to be filled up when service bolts were withdrawn. The total cost of welding was £301 ($1,459.85), comprising electrodes, £178 ($863.30); electric current, £61 ($295.85); and labor; £62 ($300.70). The cost of assembling similar barges in the same yard by the ordinary method of construction, including riveting, caulking, and drilling, was £389-8s ($1888.59), while in another yard, where ten barges were built, the average cost was £453-8s ($2108.99)."

When one realizes just how prime a part rivets play in the makeup of a modern steel ship, the value of electric welding becomes plain. In a cargo craft of 5500 tons deadweight capacity, for example, there are driven substantially 500,000 rivets, and in fabricating a 7500-ton freighter 650,000 rivets are needful to assemble and to bind together the various elements that make her a structural entity. A great many of these rivets, even with the aid of the pneumatic hammer, are driven under difficulties, and all too frequently a goodly percentage of the rivets in any vessel are found to be defective. This means that they must be cut out and driven anew. But this is by no means the whole story against the rivet.

Where plates are to be joined with angles or other plates corresponding holes must be bored in each contiguous surface, *i. e.*, at least two holes for every rivet, and in order to insure sufficient strength, lapping plates or butt straps may be double, treble, and even quadruple riveted. And what happens when these holes are not in line for the reception of the rivet? Where it is quite impossible by means of force applied in one way or another to bring the holes in alignment it is the custom to straighten out the passage by means of a reamer, and then to drive the rivet in a more or less

elliptical hole and somewhat at an angle. As a consequence, the passage is not infrequently imperfectly filled when "up-setting" the rivet during driving, and the strain upon the rivet is intensified in a seaway by the obliquity of its position. No wonder, then, that leaks develop, rivets sheer and fly out, and parts that should be held in intimate contact separate and invite disaster.

Further, riveting entails a good many operations which could be dispensed with if electric welding were substituted. For instance, it would be unnecessary to do the marking off for rivet holes, punching would be reduced to a minimum if not eliminated, reaming and countersinking would be unnecessary, and the vexation of holes that will not line up would be avoided. Electric welding promises still other gains, so the experts say. For instance, the extent of lapping, where plates are now joined by riveting, can be very materially lessened, and to just that extent reducing the amount of metal needed in a vessel's getup. Butt straps can be dispensed with, because we are told that the edges of contiguous plates can be bound together by the electric arc so that the reinforcing strength of the straps will not be essential. The extra weight represented by rivets can be done away with; and, finally, the hull surface exposed to the movement of water will be smoother and offer, therefore, less resistance than is now possible with the prevailing structural arrangement of a vessel's skin.

As everyone knows who is at all familiar with steel work, the riveted joint lap, or butt is only an approximate in strength of an unbroken plate or mass of steel of the same total thickness. The punching of the rivet holes weakens the available strength of the material, and the driving of rivets in these holes does not make up the deficiency. The question is, then, how far does electric welding improve upon this condition and approach to the original strength of the unperforated steel? To answer this query, the governmental authorities both here and in England have carried on a series of illuminating trials. Large butt-welded specimens were tested to destruction to determine the ultimate strength of electrically-welded joints and of regular riveted overlaps.

As a result, the British have found that the tensile strength of triple-riveted overlaps ranged from 65 per cent to 70 per cent of that of the unperforated plate; that the welded overlaps ran from 70 per cent to 80 per cent; while the butts welded by the arc had a strength factor of from 90 per cent to 95 per cent of the unpunched plate. Manifestly electric welding is superior to riveting in the element of tensile strength, but a ship's structure is subjected to many and varied stresses which are applied in different directions, thus setting up an alternating bending or flexing of the joints or junctures of the steel parts.

This matter is one of moment; and the technicists both here and abroad have given it a good deal of attention. Mild steel will endure for a considerable period a succession of repetitive stresses ranging from plus or minus 10 to 11 tons. The electrically-welded joint, on the other hand, up to date, is considered to be doing well if it will stand up under 5,000,000 alternating stresses having a range of from plus or minus 6½ tons. It is more than likely that this figure of "dynamic elasticity" can be bettered by improvements in the electric welding processes, and even without any gain of this sort the results indicate a weld-life of quite ten years under seagoing conditions.

It must be borne in mind that the welded ship should, to get the fullest advantages of the new system of union, be especially designed in some particulars. Similarly, the materials have to be prepared and subsequently handled somewhat differently from the practices now commonly prevailing where riveting is in vogue. The electric arc cannot bring neighboring surfaces together—cannot draw them snugly in contact as does the operation of riveting. Therefore, the parts to be joined must be held closely together so that the welding process can effect a permanent union through the agency of heat and the interposition of melted metal from the electrode.

From the very nature of things, it is desirable that overhead welding, *i. e.*, welding from the under side, should be held down to a minimum, and much of this can be avoided by doing this work while the parts to be joined in this manner are lying flat either in the shops or on the ground prior to setting up and assembling at the building slip.

Electric welding may be broadly divided into two methods: one is the arc-welding process and the other is the so-called "spot" and butt-welding process. Both of them are akin only so far as they have recourse to heat induced by the action of an electric current which serves to raise the temperature of the metals to be joined to a point where they will unite either by reason of added molten metal or by the application of pressure at the right moment. To prevent confusion it might be just as well to take up spot and butt-welding first, because this method is industrially the older one, although not so widely known or so generally practiced as arc welding.

Without going too much into details, the spot-welder apparatus consists of a suitable jaw or yoke equipped with copper electrodes between which are placed the pieces of metal which are to be heated and welded. A suitable current is then passed from electrode to electrode by way of the intervening material, which is held firmly together. The resistance to the flow of the current offered by this metal causes incandescence just as does the filament in an electric bulb, and when the steel, let us say, is glowing brightly the copper electrodes exert pressure and produce a weld at the point of contact, hence the term spot welding. This method of welding can be done by fairly unskilled labor, and satisfactory work can be effected rather rapidly. It will be realized that the union of the contiguous surfaces takes place only at each weld or spot, and, in this respect, is somewhat similar to the local binding action of rivets.

In butt welding, the pieces of metal placed between the jaws are set there so that the edges project somewhat beyond the electrodes, and because their surfaces are in contact, when heat and pressure are applied, the weld extends over the whole of the meeting surfaces and is, accordingly, a wider and stronger unit junction. In other words, it is virtually nothing more than amplified spot welding, and the same apparatus serves for both types of welds.

In arc welding much greater nicety of manipulation is required on the part of the operator, for success depends very largely upon his control of the heat induced by the arc, his maintenance of a fairly continuous arc, and the manner in which he fills in the deposited molten metal which constitutes the binding tie between the surfaces to be joined. Care, a cunning hand, and a sure eye are required even after the surfaces to be welded have been properly cleaned and otherwise made ready to be "soldered," so to speak. The electric arc, as most of us know, is the intense spark or flame produced by the current in spanning the air space between the electrodes of a broken or separated circuit. Now see how this phenomenon is applied to welding.

The materials to be welded are connected to one side, so to speak, of the electric circuit, and the electrode, which is directed by the operator, forms the other terminal. With the surfaces to be welded properly cleaned, the electrode is placed in contact, the current is turned on, and then the worker "strikes the arc" by slightly withdrawing the electrode which he holds. Instantly, the current jumps the gap which, depending upon the nature of the electrode, may range from 3/16 of an inch to 2 inches. The air space offers high resistance to the flow of the electricity, and this resistance promotes the generation of the intensely hot arc. For a satisfactory weld, it is essential that the worker should keep the electrode at a fairly uniform distance so that the arc will be steady and not a succession of discharges. Otherwise, the molten metal, instead of being deposited evenly, is laid in the form of "beads" of varying sizes, producing a spongy weld, and inviting oxidation. This objection applies especially to the use of the metallic electrode when manipulated unskilfully.

According to the General Electric Company: "Practically all arc welding is accomplished by one of two methods, referred to as either the metallic or carbon electrode method. In either case the process utilizes the heat of an electric arc formed between the electrode and the object on which the work is to be done. The arc melts a small pool of metal on the work and, in welding or building up, the additional metal is deposited in this pool in a molten state, thereby forming a firm union between the new and old metal. In the metallic electrode method, the electrode consists of a wire or rod connected by a suitable holder to one terminal of an electric current. . . . The heat, in addition to melting a small pool on the work, melts the electrode away and the current causes the metal to be driven, in finely divided particles, against the work. In this manner additional metal is built on or used to join two pieces of metal. By this method, metal can be deposited on vertical surfaces, and it is the only way in which metal can be successfully deposited overhead.

"In the carbon electrode method a carbon rod is substituted for the metal electrode. The arc fuses the metal of the work and additional metal is built on by melting from a rod of filling material in a manner similar to soldering with an iron. The metallic electrode process requires a comparatively low value of current. . . . Consequently the metal is deposited at a comparatively low rate. The metal deposited by this method is more uniform and a weld so made is slightly stronger and has a smoother and more regular appearance than one made by the carbon electrode. For these reasons the metallic electrode is usually used when strength or appearance is important. For cutting, or melting away excess stock, the carbon electrode must be used. This method is also used for building up metal, plugging holes in castings, welding, and joining parts where strength and appearance are not essential, or where the surface is to be machined off. Since heavy currents can be used metal can be built on with great rapidity, and where speed is desirable this method is applicable."

Owing to the generation of ultra-violet rays by the electric arc, it is necessary to protect both the operator's body and his eyes from certain hurtful actions. That is to say, the ultra-violet rays injure exposed flesh much after the fashion of sunburn, and the eyes must be safeguarded not only from these rays but from the wellnigh blinding brilliancy of the arc. Asbestos gloves protect the hands, and colored glasses, composed of a combination of red and green, shield the eyes both from the rays and the incandescent arc as well as from spattering particles of very hot metal.

It is not possible in a semi-technical article to go into all of the niceties of this developing art. Considerable laboratory research has been devoted to the microscopic examination of the character of the weld metal, and it has been proved that the action of the electric arc tends to increase oxidation and to vaporize away certain of the chemical or metallurgical constituents which distinguish steel from iron. That is to say, although the metal electrode and the filling material may start out as steel with certain desirable characteristics, the heat of the arc induces a transformation which will leave little better than soft iron to form the welding substance. However, the cunning of the metallurgist is gradually overcoming this drawback to the process. By plating or coating the electrode oxidation is very measurably reduced, and by giving the electrode or filling metal an excess of certain desirable ingredients, enough of these survive, despite the heat of the arc, to yield an ultimate greater factor of strength.

Among the several companies here in the United States which have gone in for the building and perfecting of electric welding apparatus is the Wilson Welder and Metals Company. The latter have developed what is termed by them a "Plastic-Arc" welder. It was this equipment which played so conspicuous a part in repairing the German ships which the Teutons had purposely damaged, as they thought, beyond prompt rehabilitation.

When we declared war on the Kaiser it was determined to take over the interned German ships for the purpose of carrying our troops and supplies

across the Atlantic. The damage to the vital parts of these vessels was of such a staggering extent that it was not considered practicable to put them in shape for service by ordinary methods in less than a year and a half. As a matter of fact, thanks to the "Plastic-Arc" and the courage of certain of our naval engineering specialists, the trick was done in six months and a total of 288,780 gross tons of sorely needed shipping was put in shape for oversea duty. Not only was a whole twelvemonth saved but an economy amounting to quite $20,000,000 was effected.

Instead of casting new cylinders and other essential parts, the wrecked sections of the engines were patched up, so to speak, just where they stood in the several craft concerned, and all that was necessary was to provide pieces to fill the fractures and to bind them firmly in place by means of electric welding. As has been said: "Arc welding on such a scale was unprecedented, but, no preheating being necessary, there being consequently no fear of distortion, the work was done without removing the cylinders. At the completion of repairs each vessel was sent to sea for a test under full power conditions for 48 hours, to ascertain whether or not the repairs were lasting, and also to determine if the ships were in condition to be trusted with the important work of transporting troops to Europe, especially when speed alone was to be depended upon in avoiding enemy submarines. Not a single defect developed on the test runs and not a single failure of the repaired parts of these ships has occurred despite the fact that they have been driven back and forth across the ocean at top speed for months."

To-day, electric welding is playing a conspicuous part in the overhaul and repair work going on at many of our shipyards, and a vast deal of time and expense is being saved in this way. The whole subject is in a state of flux, and, month by month, the inventive mind, the engineer, and practical experience are showing ways of effecting improvements. The spot welder, in the form of a yoke with a 5-foot gap, from end to end—not between electrodes—has been developed which will make it practicable to "tack" plates and parts in position, after which they can be completely welded, if needful, by the electric arc. It is believed that this will enable the shipbuilder to do away with the punching of holes and the temporary use of bolts during setting up, and will also make it feasible to bind together different elements of a ship which need not be made watertight but secured at suitable points. It is the opinion of numerous technicists that riveting can be very largely eliminated in the building of steel vessels; but for the present, at least, these binders will probably be found the more satisfactory at the bows and sterns of craft where the somewhat complex forms make it necessary to use considerable force in drawing the shell plating into place.—*The Rudder*, April.

AERONAUTICS

NAVY OCEAN FLIGHT PLANS IN DETAIL.—The navy's plans for a transatlantic flight have progressed to the point where it is now possible to give some of the particulars of the project in greater detail.

The preparations call for the use of two large naval seaplanes of the *NC* type, both of which will be started at the same time, carrying five men each. They will fly from the Rockaway (L. I.) Naval station to the east coast of Newfoundland some time after May 1, but very close to that date. This flight will not be a part of the transatlantic voyage, which will start from the east coast of Newfoundland.

It is not the plan to fly direct from Newfoundland to Ireland or England. The route will be from Newfoundland to the Azores and from the Azores to the nearest point on the coast of continental Europe, somewhere on the west coast of Portugal.

It is not the purpose, as has been previously intimated, to divide the leg between Newfoundland and the Azores into two parts. The idea now is to have the two planes continue to those islands for their first stop. About

20 officers of the navy have been assigned to transatlantic flight duty, and from these ten will be chosen for the actual flight.

The purpose in using two planes is that if one should fail, the other might succeed. Also through the use of two planes, it would be possible if one met with a mishap for the other to go to its assistance. The four *NC* planes in use are designated officially as the *NC-1*, the *NC-2*, the *NC-3* and the *NC-4*. Two of these will be chosen for the flight.

The *NC-1* was first put in commission and some weeks ago made a successful trip from Rockaway to Bolling Field and return. Recently it was damaged in a storm and put temporarily out of commission. It is hoped to get the *NC-1* ready again before the official naval voyage across the Atlantic is undertaken. The *NC-2* is now in commission at Rockaway. The other two planes are being put into shape rapidly.

The purpose in flying the planes from Rockaway to Newfoundland, it was explained, was not only to transport them to the officially selected starting point, but to test their endurance and speed qualities. The distance from Rockaway Point to the selected point on the Newfoundland Coast is 1050 miles. The flight from Rockaway to Newfoundland will be made in two leaps, with an intermediate stop at Halifax, which is about half way between Long Island and Newfoundland.

The length of the course over which the naval planes will fly has been officially plotted on hydrographic charts as measuring about 2141 nautical miles. The distance from the starting point on the Newfoundland coast to the Azores is set down as 1353 miles and from the Azores to Portugal is 788 miles. Naval vessels will be stationed between Newfoundland and the Azores, and between those islands and the Portuguese coast. The navy seaplanes will be equipped with wireless telegraph and wireless telephones to facilitate communication throughout the voyage with sea craft.

The crew of five on each navy seaplane will consist of a commanding officer, two pilots, one engine man, and one radio operator. The commanding officer will have charge of navigation and will handle all communications and give orders. He will be a pilot, but will not act as pilot except in emergency. Two pilots will be carried so one can relieve the other. In an emergency, or if both should become tired, the commanding officer would act as pilot.—*N. Y. Times*, 4/12.

WAR FLARES TO AID TRANSOCEAN FLIERS.—Flame and smoke flares developed during the war and improved recently by chemical experts of the army will be factors in the transatlantic flight to be undertaken next month by naval seaplanes. By dropping these flares at intervals, the aviators will be able to determine the drift of their planes in the cross winds and make the corrections necessary to keep them on their course.—*N. Y. Times.*

WIRELESS TO GUIDE TRANSOCEAN FLIERS.—The *Daily Mail* says that at least one of the airplanes that will compete for the transatlantic flight prize will be navigated from wireless information supplied every half hour or so by British Air Ministry officials. The pilot will send out an inquiry, and from the direction from which his message is received, wireless stations will calculate his exact position. This will be relayed by wireless to the pilot in a few minutes.

The British "Directional" wireless apparatus has been developed entirely by flying men during the war, and the Air Ministry claims it's instruments are far in advance of those of any other nation.

"Listening at their instruments in shore stations," said a wireless officer yesterday, "hundreds of miles from the spot where an airplane is battling its way across the ocean, our operators will hear a short, prearranged code from the navigator at every coast station.

"Possibly a number of battleships will record the messages and instruments now perfected, will point out in each instance the exact direction of the airplane.

"There will be a hasty conference between the stations, and within five minutes the navigator will be able to mark on his map exactly what his position was when he sent his enquiry.

"Fitted with 'directional' wireless and a good compass the airplane will be able to steer through fog or clouds without getting more than a trifling distance off its course."—*N. Y. Times*, 4/3.

British destroyers will cooperate with the American Navy in patrolling the course to be followed by American naval seaplanes in the projected flight across the Atlantic Ocean next month. It was learned to-day at the Navy Department that 40 to 50 British ships would be on duty from the Azores to the British Isles, where, under present plans, the flight will end.

American destroyers will patrol the course from St. John's, N. F., to the Azores. Fifty to sixty craft will be used and they will be stationed at intervals of less than 200 miles.

Along most of the course there will be an almost continuous stream of army transports going to and returning from France, and these vessels will form additional safeguards for the crews of the the machines in event accidents force any of the craft to descend. With reasonably good weather, however, the planes could ride on the water while minor repairs were being made to the motors.

The course of the flight will be charted in advance by naval vessels. Careful study is being made of weather conditions and the winds prevailing. As the result of experiments with radio telephones some naval officers think it will be possible for the planes to be in communication with shore throughout the flight. Each boat will be equipped with wireless outfits so as to maintain contact with patrolling destroyers and passing transports or other vessels.—*N. Y. Times*, 4/3.

BUREAU OF MINES SEARCHING FOR SPECIAL AIRPLANE FUEL.—During the war the Bureau of Mines, Department of the Interior, made strenuous efforts to find a special fuel for airplanes that would be superior to others already in use. Of the numerous products and mixtures obtained some were originated by the bureau engineers and chemists, others were suggested by outside interests. Through its own experiments or by cooperation with other organizations, notably the research division of the Dayton Metal Products Co., and the Bureau of Standards, it was possible to establish the fact that certain types of fuels had elements of superiority that had not before been noted or appreciated. Of the fuels proving most satisfields was distinctly superior to the type most extensively used. The blendfactory, gasoline refined from the crude petroleum of certain producing fields was distinctly superior to the type most extensively used. The blending of moderate proportions of benzol with gasoline was found to be distinctly advantageous, and motor fuel of this type would undoubtedly have been employed for military purposes if the war had continued much longer. It is believed that through the proper use of benzol and other distillates derived from coal, it may be possible to embody features in the design of internal combustion motors that will notably increase their efficiency. Benzol and other coal-derived fuels are already being sold for use in automobiles and are believed to be giving satisfactory results even with present types of motors.

The bureau was particularly interested in a special fuel tested in cooperation with the Dayton organization and named "hecter." This fuel was a mixture of cyclohexane and benzol, gave indications of marked superiority over any other product tested and should, unless unforeseen deficiencies appear, prove ideal for the military aviation service. In some experimental flights this fuel has given 10 miles an hour more speed. It is not certain that the cost of production will ever be low enough to permit its use in peace times, but it is planned to complete the work of obtaining comprehensive information regarding all of its possibilities and to

publish reports on the subject in cooperation with the engineers of the research division of the Dayton Metal Products Co.—*Official Bulletin*, 3/19.

TELLS OF AUTOMATIC PLANE.—*Flew 100 Miles Without a Pilot, Secretary Baker Reveals.*—Under automatic control, an airplane capable of carrying a heavy load and operated without a human guide, has made a trip of 100 miles and landed close to the point it set out to reach, Newton D. Baker, Secretary of War, disclosed in an address here to-day. Secretary Baker, with General Peyton C. March, Chief of Staff, came here to inspect Camp Bowie.

The device which made such a flight possible, and which has been kept secret, Mr. Baker said, is an automatic guide for airplanes, and was invented in America. It is designed as an instrument of war and the Secretary referred to it in describing to his audience the possible horrors of future wars if there is to be no League of Nations.

Secretary Baker did not explain the exact nature of the invention, but he made it clear that the War Department considered it one of the most wonderful pieces of mechanism for war's destructive purposes.—*N. Y. Times*, 3/25.

A remarkable long-distance flight over the North Sea, the longest non-stop oversea voyage of any British aircraft, has been performed by the non-rigid airship *N S-11*. The voyage, which took the form of a circuit embracing the coast of Denmark, Schleswig-Holstein, Heligoland, North Germany, and Holland, was characterized by extremely unfavorable weather conditions. The total length of the round trip was 1285 air miles, the time taken being 40½ hours.—*London Army and Navy Gazette*, 3/29.

BRITISH TRIPLANE CAN CARRY 100 PERSONS.—*Built to Travel Loaded 1200 Miles at More Than 80 Miles an Hour.*—The *Daily News* gives further particulars of the Tarrant super-triplane which Major Gen. Seely referred to in the House of Commons on March 13 and which is being assembled at the royal aircraft factory at Farnborough.

A striking feature is its long cigar-shaped fuselage, similar in appearance to the body of the Zeppelin machine. It was originally designed to bomb Berlin, carrying 10,000 pounds of bombs and a crew of eight over a distance of 1200 miles. It has a span of 141 feet, the fuselage is 85 feet and is fitted with six Napier Lion 506, engines.

When the aircraft industry began preparations for commercial flying the makers of the super-triplane followed suit, with the result that this type will be capable of carrying over 100 passengers, or cargo weighing nine tons, for a distance of 1200 miles. The speed of the converted machine will be anything from 80 to 100 miles per hour. It possesses enormous possibilities in continuous flying, and by extra tankage it would be possible to make a nonstop flight lasting 24 hours.

The fuselage is built of wood and strengthened by a patent system of girders not unlike the masts of an American warship, and this obviates the use of tracing wires and other fittings common to the ordinary airplane. There is freeway right down the center of the fuselage permitting anyone to walk to the tail. Three rows of glass windows, giving the appearance of portholes, will be fitted inside of the triplane, and tiers of seats will be provided for passengers.

In addition to the staff of pilots there will be on board two or three engineers and mechanics, a navigator, and a wireless operator.—*N. Y. Times*, 3/29.

WATERPROOFING AIRPLANE PROPELLERS WITH ALUMINUM LEAF.—A waterproof coating for airplane propellers, which incorporates thin aluminum leaf in the finish, was developed by the Forest Products Laboratory at Madison, Wis., and placed in production by the War Department. The

process is practically 100 per cent effective in preventing absorption of water, particularly in the storage stage. A French authority states that 80 per cent of the French propellers produced are rejected by the pilots mainly because they are out of balance. The difficulty is due largely to unequal absorption or distribution of moisture and can be greatly reduced by an effective waterproofing coating.—*Scientific American*, 3/15.

MISCELLANEOUS

INCREASE OF MOBILE ARTILLERY EQUIPMENT SINCE THE CIVIL WAR.—The following statement was prepared by the Statistics Branch, General Staff, War Department:

As a result of the Napoleonic wars the ratio of field guns to infantry armed with rifles became established at about 300 to 100,000. There were then no mobile guns other than those corresponding to the light field gun of the present, although heavy guns on fixed mounts were used to some extent in sieges.

Rifle strength is estimated in certain of the earlier cases as 85 per cent of combatant strength exclusive of cavalry. The heavy howitzers and railway artillery of the present war are excluded, on the ground that they are analogous to the old siege artillery, although to a certain extent mobile.

	Guns per 100,000 rifles	
	3-inch field	Others to 6-inch
Civil War, 1861-1865:		
Union (Bull Run)	192	....
Union (average)	386	....
Confederate (average)	[1] 418	....
Franco-Prussian War, 1870:		
French	[2] 228	....
German	267	....
Russo-Turkish War, 1877-8: Russian	354	....
Russo-Japanese War, 1905:		
Russian	[3] 356	25
Japanese	357	28
Peace basis (spring, 1914):		
French	466	21
German	412	198
War basis (October 1, 1918):		
United States	484	251
German (June 1, 1918)	498	541
British	566	529
French	714	712

TURKEY'S WAR LOSSES.—A Turkish official return gives the total losses of the Ottoman Army from the beginning of the war to the end of 1918 as:—Killed and died, 5550 officers and 431,424 men; wounded, 407,772 (officers and men); prisoners and missing, 3030 officers and 100,701 men.—*Reuter.*

The figures having reference to prisoners and missing appear to be underestimated, for it will be remembered that General Allenby during his last offensive, in conjunction with the Hedjaz Army's operations, took over 83,000 prisoners, while there is also to be taken into account the number of Turks captured in Mesopotamia, Egypt, Armenia and Gallipoli.—*Army and Navy Gazette*, 3/1.

[1] Nine and twelve pounder as against 12- to 20-pounder, Union.
[2] Muzzle loading as against German breech-loading. In addition, French had 53 mitralleuses per 100,000 men.
[3] Used only shrapnel for field-gun ammunition.

ITALIAN NAVY.—On Monday the Corriere d'Italia published the first complete list of losses sustained by the Italian Navy during the war. Altogether Italy has lost 54 units: 1 dreadnought, 2 battleships, 5 auxiliary battle cruisers, 8 destroyers, 5 torpedo-boats, 7 submarines, 9 submarine-chasers, and 17 miscellaneous ships, including minesweepers, tugboats, and supply ships. The Austrian Navy lost 45 units, including one dreadnought, 2 battleships, 2 torpedo-boats, 7 destroyers, 20 submarines, and 13 miscellaneous.—*Army and Navy Gazette*, 3/1.

The United States Government started condemnation proceedings in the federal court to determine the value of the Cape Cod Canal, which the government is to take over. The government bill which was filed by former Assistant United States District Attorney Francis H. Goodale. Condemnation proceedings were made necessary because the owners of the canal and the government representatives were unable to reach an agreement for purchase. An act of Congress authorizes the government to take over the property either by negotiation or condemnation. Papers filed by the government state that the title to the Canal is held by the Boston, Cape Cod and New York Canal Co., and that the Old Colony Trust Co. of Boston claims to be the owner and holder of the property under a mortgage. No date was set for the hearing.—*Shipping*, 4/5.

AMERICA'S RECORD SINCE ENTERING THE WAR TWO YEARS AGO

A Few of the Statistics Relating to Our Armed Forces, Casualties, Shipping, and Estimated Cost of Operations, April 6, 1917, to April 6, 1919

April 6, 1917—	
Regular Army	127,588
National Guard in Federal service	80,466
Reserve corps in service	4,000
Total of soldiers	212,034
Personnel of Navy	65,777
Marine Corps	15,627
Total armed forces	293,438
November 11, 1918—	
Army	3,764,000
Navy	497,030
Marine Corps	78,017
Total armed forces	4,339,047
Soldiers transported overseas	2,053,347
American troops in action, November 11, 1918	1,338,169
Soldiers in camps in the United States, November 11, 1918.	1,700,000
Casualties, Army and Marine Corps, A. E. F.	282,311
Death rate per thousand, A. E. F.	.057
German prisoners taken	44,000
Americans decorated by French, British, Belgian, and Italian armies, about	10,000
Number of men registered and classified under selective service law	23,700,000
Cost of thirty-two National Army cantonments and National Guard camps	$179,629,497
Students enrolled in 500 S. A. T. C. camps	170,000
Officers commissioned from training camps (exclusive of universities, etc.	80,000
Women engaged in Government war industries	2,000,000

BEHIND THE BATTLE LINES

Railway locomotives sent to France	967
Freight cars sent to France	13,174
Locomotives of foreign origin operated by A. E. F.	350
Cars of foreign origin operated by A. E. F.	973
Miles of standard gauge track laid in France	843
Warehouses, approximate area in square feet	23,000,000
Motor vehicles shipped to France	110,000

ARMS AND AMMUNITION

Persons employed in about 8,000 ordnance plants in U. S. at signing of armistice	4,000,000
Shoulder rifles made during war	2,500,000
Rounds of small arms ammunition	2,879,148,000
Machine guns and automatic rifles	181,662
High explosive shells	4,250,000
Gas shells	500,000
Shrapnel	7,250,000
Gas masks, extra canisters, and horse masks	8,500,000

NAVY AND MERCHANT SHIPPING

Warships at beginning of war	197
Warships at end of war	2,003
Small boats built	800
Submarine chasers built	355
Merchant ships armed	2,500
Naval bases in European waters and the Azores	54
Shipbuilding yards (merchant marine) increased from 61 to more than 200.	
Shipbuilding ways increased from 235 to more than 1,000.	
Ships delivered to Shipping Board by end of 1918	592
Deadweight tonnage of ships delivered	3,423,495

FINANCES OF THE WAR

Total cost, approximately	$24,620,000,000
Credits to 11 nations	8,841,657,000
Raised by taxation in 1918	3,694,000,000
Raised by Liberty Loans	14,000,000,000
War Savings Stamps to November, 1918	834,253,000
War relief gifts, estimated	4,000,000,000

—*N. Y. Times*, 4/6.

NAVY WILL CONDUCT NATIONAL RIFLE COMPETITION THIS YEAR.—*Location and Date Not Yet Decided, but Matches Will Be Held Sometime in August.*—Acting Secretary of the Navy Roosevelt announces that at the invitation of the War Department the United States Navy will conduct the national matches for the year 1919, and that these great competitions, wherein soldiers, sailors, marines, and civilians compete for national marksmanship honors, will be held on one of the large rifle ranges. The exact location and date have not yet been determined but the matches will be held sometime in August.

Lieut. Col. William C. Harllee, United States Marine Corps, who has been active for many years in matters pertaining to marksmanship and who conceived the idea for the chain of navy rifle ranges which were put into commission during the war, has been named executive officer of the competitions. On the staff will be named officers from the army, navy, marine corps, and the National Rifle Association.

The national matches have been staged at frequent intervals during the past decade, and are the means of determining the national rifle and pistol championships.

At the matches are usually in attendance 50 or more teams representing the services national guard and civilian organizations, colleges, military schools, and many hundreds of individual marksmen. This year, owing to rifle practice, 100 teams are expected to compete.

The policy of admitting civilian teams, one or more from each state, inaugurated in 1919 will prevail in the 1919 competitions. Particulars in regard to the admission of teams and other arrangements for the matches can be secured by addressing Executive Officer, National Matches, Room 1108, Woodward Building, Washington, D. C.—*Official Bulletin*, 3/22.

GERMANS TOOK 4765 U. S. MEN; 4376 REPORTED FREE, 233 DEAD.—The Statistics Branch, General Staff, War Department, issues the following:

Revision of prisoners records, which have been compiled from reports of prisoners from all sources, for the purpose of eliminating duplicate names, brings the total number of military prisoners taken to 4765. Of these 4376 have been reported released and 233 dead. The list of 156 names of prisoners whose status is still doubtful was forwarded on March 20 to the Central Records Office, A. E. F., for checking and investigation.

The record of army, marine, and civilian prisoners taken by the central powers as of March 20, is as follows:

	Army	Marine	Civilian
Taken prisoners	4,686	79	281
Died	229	4	...
Release recorded	4,304	72	116
Status doubtful	153	3	165

The following table shows by rank the number of military prisoners taken and the number reported dead:

	Taken prisoner	Died
Lieutenant colonel	1	...
Major	4	...
Captain	27	3
First lieutenant	262	29
Second lieutenant	101	17
Total officers	395	49
Enlisted men	4,370	184
Total	4,765	233

—*Official Bulletin*, 3/26.

A TIME-HONORED CUSTOM THREATENED.—According to the Portsmouth correspondent of the *Times*, there is some possibility of the time-honored custom of hoisting the Union flag at the peak and firing a gun on the occasion of a court-martial being abandoned. It seems that the practice has fallen into disuse during the war, owing to the majority of courts-martial being held on shore instead of afloat—to allow of which the Naval Discipline Act was amended in March, 1915. Formerly, courts could only be convened on board ship, and it may be recalled that a special act of Parliament was needed in George III's reign to enable the trial of Admiral Keppel to be held on shore by reason of the infirm state of the admiral's health. The last time the practice of hoisting the Union flag and firing a gun was carried out was when Admiral Troubridge was tried by court-martial at Portland in 1914. Merely because it is a pity that old customs should disappear we venture to protest against any decision being hastily

taken in this matter. It would be interesting to know when the practice of hoisting a flag to denote the venue of the court-martial was instituted and whether it was ordered or, like many other naval customs, was observed without being specially sanctioned by law. The *Manual of Naval Law* is silent on the point, although it does show that a custom as the laying of his sword *across* the table when the prisoner is an officer and *along* the table with its hilt towards him if acquitted, and *vice versa*, has long ago been embodied in the regulations.—*London Army and Navy Gazette*, 3/1.

PROPERTY OF OUR ARMY WILL BE SOLD TO FRANCE.—Docks, railroads, warehouses, hospitals, and barracks built by the American Expeditionary Force, to the value of $165,000,000, will be sold to France for the best figures the American Liquidation Commission can obtain. None of these can readily or profitably be removed, and the only alternative is to sell at the best bargain.

The Liquidation Commission is now negotiating for the disposal of various surplus properties belonging to the expeditionary force. Hundreds of thousands of uniforms have been dyed, so that they may now serve other armies, such as those of Belgium, Poland, and some of the Balkan States.

The present plan is to dispose of these surplus supplies among the governments which need them.—*N. Y. Times*, 3/19.

CURRENT NAVAL AND PROFESSIONAL PAPERS

UNITED STATES

WORLD'S WORK. **April.**—How Beatty Put to Sea, by *Lieut. Francis T. Hunter*, U. S. N. R.

CENTURY. **April.**—The Larger American Navy, by *Rear Admiral Charles J. Badger*, U. S. N. China's Case at the Peace Conference, by *Thomas F. Millard*.

SCIENTIFIC AMERICAN. **March 22.**—U. S. Navy 7-inch Caterpillar Mount, by *Commander H. Delano*, U. S. N.

March 29.—Radium and Radio-Activity, by *Charles H. Viol*. A 121-Mile Gun, by *J. Bernard Walker*.

April 5.—Hunting Submarines with a Sound Detector, by *Brewster S. Beach*. U. S. S. *New Mexico*, by *Henderson B. Gregory*.

April 12.—The New American Merchant Marine (I), by *Edward W. Hurley*. The Marine Diesel Oil Engine, by *John W. Anderson*. Salvage Work in New York Harbor. Is the Dirigible Outstripping the Airplane?

FLYING. **April.**—Who Will Be the First to Cross the Atlantic? by *Henry Woodhouse*. A Proposed Airplane Route Across the Atlantic, by *Prof. Wm. H. Hobbs*.

FRANKLIN INSTITUTE. **April.**—The Visibility of Airplanes (illus.), by *M. Luckeish*. The Color of Water, by *Wilder D. Bancroft*.

GREAT BRITAIN

EDINBURGH REVIEW. **January.**—Ships and Empire, by *David Hannay.*

NINETEENTH CENTURY AND AFTER. **March.**—Could the Fleet Have Forced the Straits? by *Major Gen. Sir Charles Callwell.*

QUARTERLY REVIEW. **January.**—The Freedom of the Seas, by *J. Pawly Bate.*

ENGINEERING. **March 21.**—The War Development of the Torpedo-Boat Destroyer (five pages of illustrations). Naval Engineers.

March 28.—H. M. Seaplane Carrying Ship *Argus* (illus.)

CONTINENTAL

RIVISTA GENERALE DE MARINA. **Spain.**—Movement of Floating Mines in the North Atlantic and Arctic, by the *Prince of Monaco.*

DIPLOMATIC NOTES

FROM MARCH 20 TO APRIL 20

PREPARED BY

ALLAN WESTCOTT, Associate Professor, U. S. Naval Academy

PEACE TREATY READY FOR GERMANY

FOUR PREMIERS ACT ALONE.—On March 24 it was announced that the so-called "Council of Ten" of the Peace Conference had been discontinued except as a war council to consider immediate military questions, and that, in order to expedite work on the peace treaty, consultations would thereafter include only President Wilson and Premiers Lloyd George, Clemenceau, and Orlando.

FRENCH DEMAND SAAR COAL FIELDS.—On March 28 Premier Clemenceau further complicated the frontier problem by presenting a demand that France should be restored to the boundaries fixed by the Treaty of Paris, of May 30, 1814, together with the Saar Basin. In the Rhine Province, on the left bank of the Rhine, Premier Clemenceau also requested that while the Germans should have political autonomy, they should not be permitted to establish fortifications, occupy the territory with armed forces, nor control the railways.

After continued negotiations, it was announced by the middle of April that the Peace Treaty would dispose of the Saar question by giving the coal mines to France in fee simple, as a recompense for destroyed French mines, and by granting territorial control to France for 15 years, under supervision of an international commission of five members. At the end of 15 years the inhabitants would choose their allegiance by a plebiscite.

An Associated Press despatch from Berlin, April 14, declared the Ebert Government would "resolutely reject any proposal to tear the Saar territory from Germany by means of a general plebiscite."

GERMANY THREATENS PASSIVE RESISTANCE AND BOLSHEVISM.—Semi-official announcement of the terms of the Peace Treaty in April stirred Germany to threats of refusal to sign and of a policy of passive resistance. On April 14 the *Tageszeitung* reported that the Berlin Cabinet, soon after the Hungarian Revolution, had considered an offer of alliance and an army of 500,000 men from Russia. But active resistance by Germany was regarded as out of the question.

Anticipating Germany's refusal to sign the treaty, the Peace Conference requested Marshal Foch to consider the measures to be employed in such a contingency. Continued blockade, cutting off of food supplies, and further occupation of German territory were suggested.

Semi-official French announcements of the conditions to be laid down in the treaty of peace are denounced by the German press.

Prince Lichnowsky, in an article in the *Tageblatt*, says that France "forgets that, instead of leading to disarmament, an unjustly extorted peace will bring forth only fresh armaments, throwing into the shade all former armaments, because a mailed-fist peace can be maintained only by the mailed fist."

Declaring that a peace of violence must be absolutely rejected, he concludes:

"Nobody can recommence the war against us. Neither can we be starved out, without the common enemy, communism and terrorism, throwing all mankind back into its primitive state."

Vorwärts says:

"No German Government can sign such terms. The entente statesmen must themselves settle with the inhabitants of the Sarre Valley, who are thoroughly German, and they may find that the sums proposed as indemnity cannot be extracted, even if the last sheet is taken from our beds."

The *Lokal-Anzeiger* says:

"No more shameless mockery of President Wilson's 'fourteen points' can be imagined than the proposed solution of the eastern question."—*N. Y. Times*, 16/4.

ITALY PRESSES FIUME ISSUE.—As early as March 21 it was reported that the Italian delegation had threatened to withdraw from the Peace Conference unless Fiume were assigned to Italy contemporaneously with the conclusion of peace. This threat may have had some influence upon the decision of the associated powers to incorporate the terms to all belligerents in a single treaty.

The Adriatic question was not finally taken up, however, until April 18-19, when Baron Sonnino, who signed the Treaty of London upon the fulfilment of which Italy insisted, presented the Italian claims. Following a decision of the Council of Premiers against Italy, the Italian delegates withdrew from the Peace Conference. President Wilson issued a statement justifying his position on the question.

LEAGUE OF NATIONS COVENANT COMPLETED

MONROE DOCTRINE AMENDMENT ADOPTED.—After long debate, and in response to insistent pressure from the United States, the following amendment recognizing the Monroe Doctrine was inserted in the League of Nations Covenant on April 10:

Article X.—A—Nothing in this covenant shall be deemed to affect the validity of international engagements, such as treaties of arbitration or regional understandings like the Monroe Doctrine, for securing the maintenance of peace.

RACE EQUALITY AMENDMENT DEFEATED.—An amendment to the League Covenant presented by the Japanese members of the drafting committee, and providing recognition of the principle of racial equality, was defeated in the committee, 11 members voting in favor and 6 against it, whereas unanimous consent was required. The Japanese reserved the right to raise the question again in plenary sessions of the Conference.

GENEVA TO BE SEAT OF LEAGUE.—Geneva was selected as the permanent seat of the League of Nations by a vote of 12 to 6, France with two votes, and China, Czechoslovakia, Portugal, and Belgium voting in favor of Brussels. The choice was influenced by a speech from President Wilson favoring Geneva as more indubitably neutral than Brussels.

EX-KAISER TO BE PLACED ON TRIAL.—On April 9 the Council of Four came to the decision that the former Kaiser should be indicted and brought to trial on charges of violation of international morality and violation of the sanctity of treaties. These offenses were considered political rather than legal; and in the Responsibility Commission, which investigated the question, Secretary Lansing objected to prosecution on the ground that the charges would not bear legal scrutiny and that a sovereign could not be held legally responsible for his actions. The indictment signed by the four premiers provided for trial by a special court for violations of international morality.

INDEMNITY QUESTION SETTLED

The following Associated Press despatch gives a summary of the indemnity provisions decided upon by the Peace Conference. It will be noted that the sum mentioned, $23,800,000,000, is a mininum, the indemnity commission having power to increase the amount "to the utmost of Germany's capacity to pay, within the limitation of her indebtedness." Some dissatisfaction was caused by the tentative allotment of the indemnity giving France about 55 per cent, Great Britain from 20 to 30 per cent, and only 25 to 15 per cent to the smaller Allied States. The press summary follows:

One hundred billion gold marks ($23,800,000,000), is the amount Germany must pay the allied and associated governments for losses and damage caused in the war, plus other billions to be determined by a special commission on which Germany is to be represented. The payment of 100,000,000,000 gold marks is to be divided into three distinct amounts as follows:

First—Twenty billions within two years.

Second—Forty billions during thirty years beginning in 1921.

Third—Forty billions when a commission shall determine how it shall be done.

An authoritative statement was obtained to-day concerning the final terms of the settlements. This sums up the conditions as follows:

Germany is at the outset held generally responsible for losses and damages in accordance with President Wilson's fourteen points and the Allied response at the time the armistice was concluded. To determine the extent of the payment under this responsibility a commission is set up to take testimony, assemble data, and arrange all details of the payment from the enemy and distribution among the allied and associated powers.

While the commission will administer the details of the payments, sufficient is known to permit the determination that an initial payment will be required of 20,000,000,000 gold marks, payable in two years without interest. It has also been determined that 40,000,000,000 gold marks shall be payable in bonds extending over a period of thirty years, beginning in 1921, with a sinking fund beginning in 1926.

These 40,000,000,000 marks draw 2½ per cent interest from 1921 to 1926, and 5 per cent interest from 1926.

In addition to the foregoing payments, Germany will also be required to deliver additional bonds for 40,000,000,000 marks, when the commission determines that this shall be done. These three payments of twenty, forty, and forty billions bring the total to 100,000,000,000 gold marks.

Beyond this total, the commission is empowered to fix anything more that may be required to cover Germany's indebtedness.

"In other words," concluded the eminent American authority who framed the terms and furnished the foregoing summary, "a commission is set up with power to collect from Germany to the utmost of her capacity to pay, within the limitation of her indebtedness."

The allotment of the 100,000,000,000 marks among the allied and associated powers has not yet been finally decided, but a tentative arrangement makes the allotment of France about 55 per cent of the total, Great Britain's allotment between 20 and 30 per cent, and the allotment of the United States between 2 and 5 per cent.—*N. Y. Times*, 15/4.

DATE SET FOR GERMAN DELEGATES

On April 15 a formal invitation was issued by the Council of Four to the German Government to send its representatives to Versailles on April 25. It was stated that the German mission would probably number about 200 persons. The Paris *Temps* stated on April 16 that Germany would be allowed only until May 15 to decide whether or not she would sign the treaty.

FRANCE AND BRITAIN IN CLOSER AGREEMENT

It is learned that the new arrangement between France and Great Britain, which some describe as a defensive alliance, is stronger than the old *entente cordiale* in that it contains a definite agreement on Great Britain's part to use her military forces in defence of France should the latter be attacked by an enemy.

The provision for the employment of military forces was not contained in the agreement itself, but in a separate note signed by Sir Edward (now Viscount) Grey, Secretary of State for Foreign Affairs—this note giving assurance that Great Britain would come to the assistance of France if necessary. A mere note, however, has no definite binding force, and the new undertaking on Great Britain's part is understood to be much more formal and final.

This arrangement between Great Britain and France is of interest in its bearing on the character of the undertaking sanctioned by President Wilson for American assistance to France in the event of German aggression.

How far the American assurances go is not yet disclosed, but the inference is drawn from the character of the British agreement that the President has met the French half way in their demand for special guarantees from Great Britain and America for the protection of the French frontiers from enemy attack.

American officials decline to say whether Mr. Wilson has actually given Premier Clemenceau a signed document containing assurances which, as has been stated in Paris despatches to *The New York Times*, engage the President of the United States to lay before Congress information of any enemy attack on France with the recommendation that such an attack be considered *a casus belli* by the United States.

French officials, however, continue to back up their statements that satisfactory guarantees have been given by President Wilson on behalf of the United States, and American officials have not withdrawn their admission that guarantees that satisfy French apprehensions have been furnished by the President.—*N. Y. Times*, 20/4.

GREAT BRITAIN

BY-ELECTIONS AGAINST LLOYD GEORGE.—By-elections in West Leighton, which in December gave a coalitionist candidate a majority of 6000 over his Liberal opponent, resulted in the election of a Liberal by a majority of 2000. Central Hull in April also went Liberal for the first time since it became a parliamentary constituency. While these elections indicated a change of sentiment since December, they were interpreted in England as a vote for a "clean peace" and a "Wilson peace." Commander Hull, the victor in the Hull election, said that he interpreted it as a warning "that if the government and the Big Four in Paris could not make a just peace soon they must give way to persons who could, but if Lloyd George was standing by President Wilson and resisting Chanvinistic demands for an unclean peace of the old-fashioned sort, then Hull's vote would strengthen him very much."

PERSONAL AND PARLIAMENTARY TRIUMPH FOR LLOYD GEORGE.—During a flying visit to England, Premier Lloyd George, on April 16, answered his opponents in a vigorous speech in the House of Commons. Without revealing the terms of the Treaty, the premier declared that his pledges to the country would be embodied in the document. He bitterly attached Lord Northcliffe and his newspapers, creating apparently a permanent breach between himself and Northcliffe press. He declared that "complete understanding on the great fundamental peace questions" existed at the Conference. Referring to Russia, he denied that the question of recognition of the Bolsheviki had been even discussed, but added, "I would rather leave Russia Bolshevist until she sees her way out of it than to see Britain bankrupt." Munitions would be supplied to the opponents of the Bolsheviki, and forces would be organized in all allied countries "bordering on the Bolshevist territory, from the Baltic to the Black Sea—Poland, Czechoslovakia, and Rumania." While the premier's speech was regarded as a parliamentary victory, it failed to silence opposition to his leadership.

QUIET RESTORED IN EGYPT.—An official statement issued at the headquarters of General Allenby, Special High Commissioner for Egypt and the Sudan, to-day, reads:

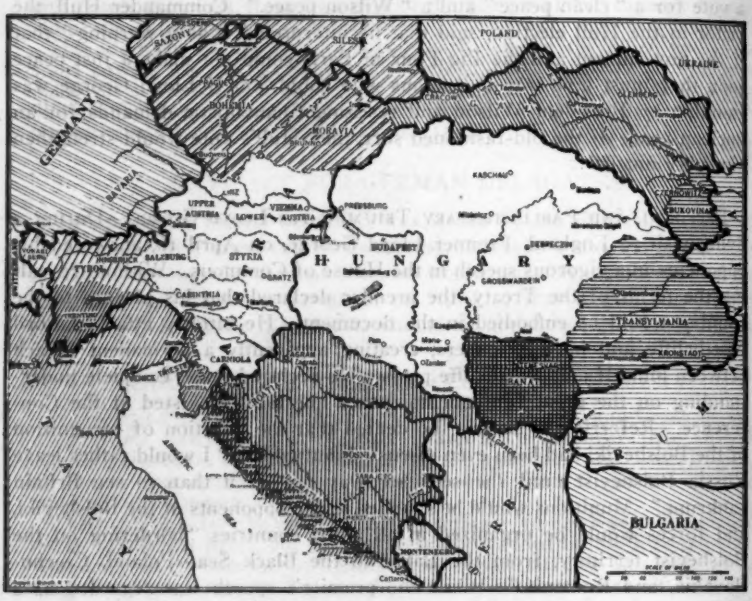
"Since noon yesterday quiet has prevailed throughout Egypt. An attempt on Thursday to tamper with a railway resulted in five arrests, while attempts to interfere with telegraphic communication resulted in the village of Beni Sembil being surrounded and given three days in which to produce the guilty persons. On Friday two rioters were killed and one was wounded when they were caught cutting telephone wires near Quesna."—*N. Y. Times*, 15/4.

SOVIET RULE IN HUNGARY

On March 22 Count Karolyi, Provisional President of the Hungarian People's Republic, resigned together with his Cabinet and turned the government over to Socialist-Communistic control. Upon resigning, Count Karolyi issued the following manifesto appealing to "the proletariat of the world" against the designs of the Allies in Hungary:

"The Entente Mission declared that it intends to regard the demarcation line as the political frontier. The aim of further occupation of the country is manifestly to make Hungary the jumping-off ground and the region of operations against the Russian Soviet army which is fighting on our frontier. The land evacuated by us, however, is to be the pay of the Czech troops, by means of whom the Russian Soviet army is to be overcome.

"As Provisional President of the Hungarian People's Republic, I turn as against the Paris Peace Conference to the proletariat of the world for justice and support."



WHAT IS LEFT OF HUNGARY

Austria, as it will be, is represented by the unshaded portion. The status of the other areas is as follows: Bohemia, Moravia, and Austrian Silesia will go to Czechoslovakia; Galicia is in dispute between the Poles and Ukrainians; Transylvania and the Bukowina will go to Rumania; the Banat is in dispute between the Jugoslavs and Rumanians; Croatia, Slavonia, Bosnia, and Herzegovina will be taken by the Jugoslavs; Dalmatia is in dispute between the Italians and Jugoslavs, but late cables say it will go to the latter on the understanding that Italy shall have Fiume; Istria probably will go to Italy with the Trentino; the Tyrol probably will go in part to Italy.—*N. Y. Times*, 30/3.

Without opposition, and apparently with the sanction of the former ruling powers, a "Revolutionary Government of Workers', Peasants', and Soldiers' Councils" at once took control in Hungary and issued a proclamation declaring "a dictatorship of the proletariat" and a policy of socialization of property and "armed alliance with the proletariat of Russia." Alexander Garbai became Premier or President of the New Government, and Bela Kun Foreign Minister.

On March 28, it was reported that Hungary had declared war on Serbia, Rumania, and other surrounding states, with promises of support from the Soviet Government of Russia. At the same time, however, the Hungarian Foreign Minister, Bela Kun, assumed a less hostile tone toward the Entente and gave assurances for the safety of foreign missions at Budapest. Rumanian armies, in cooperation with French forces, proceeded early in April to occupy the new eastern line of demarcation fixed by the Paris Conference.

GENERAL SMUTS FAILS TO MAKE TERMS.—General Smuts, as emissary of the Peace Conference, on April 5 submitted proposals to the new Hungarian Government to the effect that a neutral zone be established along the new line of demarcation, that the armistice terms of November 13 be continued, that the blockade be raised, and that Hungarian representatives be sent to Paris to confer before final determination of political frontiers. These terms the Hungarian Government refused to accept, but submitted the following counter-proposals to General Smuts on his departure:

"Relying on the good will displayed in such an unaccustomed manner by you, we beg you to interpret the following proposals to the Entente Powers:

"First, the Soviet Government also is disposed to create a neutral zone, but solely on the condition that the frontier thereof is shifted eastward to the Maros line, and that the Soviet Republic shall administer without interference in the territory occupied by the allied troops, thus allowing the Soviet Republic to be re-established in Szegedin and Arad. There shall be free intercourse from the neutral zone both in the direction of Hungary and Rumania and free transit in the Transylvanian territory occupied by Rumania.

"Second, At the same time we request the complete raising of the blockade and the supplying of the republic with coal and fats.

"Third, We request that the proposed conference should include representatives of the Hungarian Soviet Republic, Bohemia, Rumania, Serbia, Jugoslavia, and German-Austria and that it meet at the earliest moment possible at Prague or Vienna, so as to proceed simultaneously with the Peace Conference.

"Fourth, we request an exchange of economic representatives between Hungary and foreign states.

"Fifth, we request the Entente Powers immediately to cease the barbarous persecutions to which every labor movement in the occupied regions is subjected."

The document is signed by Premier Garbai and Foreign Minister Bela Kun.

GERMANY

SPARTICIDE OUTBREAK IN SAXONY.—Herr Neuring, War Minister in the government of Saxony, was killed at Dresden on April 12 by a mob of soldiers, who, it was charged, had been refused a hearing. The trouble arose through fear that the reduction of pay to peace rates, ordered by the National Government, would be at once enforced in Saxony. The minister was thrown into the Elbe and shot at and killed as he attempted to swim ashore. The official version of the affair attributed it to Russian agents in the employ of the "Red Soldiers' League."

RIVAL GOVERNMENTS IN BAVARIA.—On April 7 the Revolutionary Central Council of Bavaria seized control of the government, proclaimed a Soviet Republic, and announced a provisional cabinet or list of "people's mandatories," including Dr. William Mühlon as Foreign Minister. Premier Hoffmann, who was in Berlin at the time when his government was overthrown, at once returned, established headquarters at Bamberg, and, with the recognition and support of the Ebert National Government, succeeded on April 12 in reestablishing temporary control in Munich.

During the week of April 20, however, the Bolshevists were again in control, virtual anarchy prevailing in Munich, and an army organized by the Hoffmann Government marching against the city. The peasants, who controlled the situation through possession of the food supply, were reported as still loyal to the Hoffmann Régime.

POLAND

RAIL ROUTE FOR TROOPS TO POLAND.—On March 26 General Nudant, representing Marshal Foch, presented a note to the German Government demanding a passage through the port of Danzig for the Polish divisions in France under General Haller which were to be sent to Poland. To this request the German Government objected on the grounds (1) that the armistice provided transit of Allied troops through Germany only for employment against Russia, and (2) that, as indicated during the journey of Premier Paderewski across German soil, the landing of Polish troops at Danzig would give rise to opposition beyond the German Government's control.

On April 4, Chairman Erzberger of the German Armistice Commission signed at Spa an agreement providing that the Polish troops should be transported to Warsaw by rail, on the condition, however, that should their passage provoke disturbances, the Allies would claim the right to land all troops at Danzig. This arrangement satisfied Germany and at the same time made possible a more rapid movement of troops. On April 15 the first contingent of the Polish Army started across Germany accompanied by Allied officers.

PADEREWSKI URGES CESSION OF DANZIG.—Premier Paderewski arrived in Paris on April 6, with the object of securing the cession of Danzig to Poland. According to unofficial reports, the Council of Four of the Peace Conference decided on April 18 to internationalize the port of Danzig, and give the Poles a "corridor" running from that city to their frontier.

FAR EAST

JAPAN'S TROUBLES IN KOREA.—The agitation for Korean independence, which began about March 1, has increased in seriousness. For the most part the revolutionary movement has been passive, the Koreans being without weapons or will for active resistance; but from all reports, the Japanese have resorted to severe measures in its suppression. Representatives of Korea in the United States issued in March a bill of grievances

reciting the oppressions of Japanese rule during the last ten years, such as enforced use of the Japanese language, compulsory sale of land, military espionage, and restrictions upon education.

A Peking despatch of April 12 stated that a Korean Provisional Government had been formed at Seoul.

CHINA URGES NULLIFICATION OF AGREEMENTS WITH JAPAN.—Nullification of the 21 demands made by Japan early in 1915 is urged by the Chinese Government in an official statement cabled from Peking and received here to-day.

The Peking statement declares that the Japanese treaties and notes forced upon China in 1915 should be abrogated "because their terms are incompatible with the principles upon which the League of Nations is founded." The statement is largely a reply to a recent statement made by Baron Makino of the Japanese delegation on the position of Japan.

"Since the Japanese delegate in Paris," the Chinese statement says, "has pointedly referred to the 21 demands, it is incumbent upon the Chinese Government to draw attention to the fact that China's acquiescence to terms subversive of her own interests were secured by means of an ultimatum to which she was forced to surrender because of the preoccupation of the rest of the world in the European war. It is a fact that the terms were imposed upon China at the point of the bayonet, the example followed being that of Prussia; the extension to 99 years of the lease of Port Arthur and South Manchurian railway concessions being precisely the German Shantung terms.

"In the subsequent agreement secured by Japan under the former Cabinet the principles followed have been equally dangerous, not only to China's liberty of action, but to her very independence."

The statement says that the claim of Japan to special privileges because the Japanese expelled the Germans from Shantung contrasts oddly with the failure of the Americans to claim the railways and mines of France, although the Germans were expelled from Alsace and Lorraine by the co-operation of the American Army. It says that the American Army of 2,000,000 lost more than 60 times the number of lives that Japan asserts she lost at Tsing-Tao. The statement also comments on the fact that England is not asking Belgium for a single concession, although Flanders "is one vast cemetery where English soldiers are buried."—*N. Y.* Times, 7/4.

RUSSIA

FOOD RELIEF FOR RUSSIA.—On April 16 an agreement was reached by the Associated Powers to send food to Russia under neutral supervision, though the French representatives raised some objections on the ground that this action might involve recognition of the Soviet Government.

The agreement stipulated that the Bolsheviki must cease hostilities. The relief work was put under a commission of Swiss and Scandinavians headed by Dr. Fridtjof Nansen, the Norwegian explorer. The distribution, it was suggested, should be handled by the Russians themselves.

ITALY

ADRIATIC BLOCKADE LIFTED.—The Italian delegation to-day notified the Peace Conference of the lifting of the military and commercial blockade in the Adriatic by which trading returns to conditions before the war, except that, until peace is declared, allied warships will have the right to search merchantmen.

The lifting of the blockade, in the light of complaints which have been made against it, is likely to relieve the food situation in Croatia and possibly further north, in Hungary, German Austria, and Bohemia.—*N. Y. Times*, 27/3.

TRADE REOPENED.—By decision of the military authorities of the Allied Governments, the Rhine has been opened for traffic with Switzerland, and shipments from the United States may now be forwarded to Switzerland by that route. The following countries and places with which, by reason of the blockade, trade was prohibited during the war, have since the signing of the armistice been opened for the resumption of trade by order of the War Trade Board: Siberia, Alsace-Lorraine, Palestine and Syria, Mesopotamia, Serbia and Rumania, the territory included in the line established by Article 3 of the military clause of the armistice protocol of November 3; Czecho-slovakia, Bulgaria, Turkey and Black Sea ports, the German colonies, the occupied territory of Germany, Adriatic ports, Albania and Montenegro, Luxemburg, the territory adjacent to and dependent upon the Adriatic ports, including Albania, Montenegro, Croatia, Slavonia, Bosnia, Herzegovina, and Dalmatia; Poland, Esthonia, and German Austria.

REVIEW OF BOOKS
ON
SUBJECTS OF PROFESSIONAL INTEREST

"Naval Power in the War." By Commander C. C. Gill, U. S. Navy. Price $1.50. (Published by George H. Doran Company, New York.)

Chapter I. The importance of naval power is shown. While admitting the great importance of naval power in the war, it is nevertheless believed that the author's statement, "Naval strategy was the grand strategy of the war," is an exaggeration. Except for strategy in its purely passive form, there was little real strategy in the war on the sea; Von Spee was really the only one who had an interesting strategical problem to solve. It is true that the naval blockade was possibly the one factor which—all the other factors being equal—gave the Allies the decision, but a decisive factor is not necessarily the most important factor. As an example, had there been unity of command in the Allied armies earlier, the war would in all probability have been decided before the blockade exerted its decisive influence.

Chapter II. Sea power, sea control and the plans of the opposing nations are discussed. Again the author claims that "naval power dominated the military situation."

Chapter III. The strengths of the opposing navies are accurately given. In the North Sea, the British had 33 vessels of the dreadnought type against 20 for the Germans. In the Mediterranean, France had four dreadnoughts and 18 pre-dreadnoughts against four dreadnoughts and six pre-dreadnoughts for Austria. The opening moves in the North Sea, the escape of the *Goeben* and *Breslau*, and the action between the *Emden* and *Sidney* are described.

Chapter IV. The action in Heligoland Bight is given in concise form and Vice Admiral Beatty's report quoted in full.

Chapter V. The salient features of the actions off Coronel and Falkland Islands are given. The author's criticism of Sturdee for sending the *Bristol*, which had three knots more speed than the German light cruisers, in chase of three merchantmen is very proper, but, as he notes, there may have been some good reason for this, and also, when a quick decision is necessary, it is easy for mistakes to be made, and, once made, it is often a greater disadvantage to make changes than to continue the original orders, even though they may not be the best possible.

Chapter VI. The description of the Dardanelles operation is clear and concise. It is one of the best in the book.

Chapters VII-VIII. A short description of the battle of the Dogger Bank is given. The battle of Jutland is described in more detail. It is, however, very difficult to describe such a complicated action without

sketches. Several sketches, even if only approximately correct, give a better idea of such a battle than many printed pages. The comments on the battle are impartial and excellent.

Chapters IX-X. Submarine warfare and anti-submarine tactics are clearly and concisely described. It is believed that the author exaggerates somewhat the submerged speed and radius of the submarine. It is also considered that submarine commanders usually fire at nearer 500 yards than the 1000 yards given by Commander Gill as their normal firing range.

Chapter XI. The part played by the United States is shown by quoting at length from the annual report of the Secretary of the Navy.

Chapter XII. The author discusses the types of naval vessels necessary for a well-rounded navy.

General comment. This book is evidently written for popular consumption. It places before the civilian reader the salient points of the actions in the war and in a general and interesting way shows him the uses of the various types of ships, and the broad outlines of strategy and tactics on the sea. H. H. F.

"A Book of the Sea." Selected and Arranged by Lady Sybil Scott. (Dedicated to the memory of the officers and men of the mercantile marine and the auxiliary services who have died at sea in the war.) 7 s. 6 d. net. 450 pages. (Oxford University Press, 1918.)

Neatly bound, promising of title, of almost pocket size, this is a book that will be picked up with curiosity by followers of the sea; and it will be an inevitable gift book from kinsfolk and friends. But the nautical reader may be disappointed. It is not a selection of the kind of poetry a sailor is supposed to like; it is not a selection of poems interpreting his feelings, or celebrating the heroic and poetic aspects of his life in peace and war. Rather its main purpose seems to be to illustrate the kind of poetry that, since poetry began, has been inspired by the sea. As the editor says, "favor has been shown to passages descriptive rather of the influence of the wonder and beauty of the sea on the mind of the poet than of the struggles of the sailor with the wind and waves." So much by way of classification. The naval reader may find verse more to his taste in Masefield's "Sailor's Garland" or Stone's "Sea Songs and Ballads." But in the 450 pages of Lady Scott's volume he will probably find better poetry, and he will surely find many a line or poem that is stirring, memorable, expressive of his own unvoiced feeling or thought.

It is a commonplace that English poetry is filled with the breath of the sea. This might be better illustrated in some other anthology. From this one, the disappointing impression is gathered that later English poetry, to a greater extent than Greek or early English, is the poetry not so much of a sea-faring people, as of people who live near the sea. The sea is there, but felt and interpreted by a shore-dweller rather than a voyager. One who has come from a winter's vigil in northern waters, for instance, might find a more immediate appeal in the Anglo-Saxon "Sea Farer" than in anything in Shakespeare. This is a part of it, diluted in modern English:

"... How I on the ice-cold sea passed the winter in exile,
In wretchedness, robbed of my kinsmen, with icicles hung.
The hail flew in showers about me; and there heard I only
The roar of the sea, ice-cold waves, and the song of the swan;
For pastime the gannets' cry served me; the kittiwakes' chatter
For laughter of men; and for mead-drink the call of the sea-mews. . . .
The shadows of night became darker, it snowed from the north.
The world was enchained by the frost; hail fell upon earth—
'Twas the coldest of grain. Yet the thoughts of my heart now are throbbing
To test the salt streams, the salt waves in tumultuous play.
Desire in my heart ever urges my spirit to wander,
To seek out the home of the stranger in lands afar off."

Another point apparent in the volume is the refusal of poets to recognize that for almost the last hundred years the great instrument in man's mastery of the ocean has been steam. The selections here are of course chiefly from the past; even so, is it not astonishing that in these 450 pages there are but two suggestions of the fact of modern motive power? One is from Masefield:

"Dirty British coaster with a salt-caked smokestack
Butting through the Channel in the mad March days."

The other is in one of the two selections from Kipling, who has seen clearly enough that machinery has not banished romance. Admiral Mahan has somewhere noted this poetic blindness or aversion, quoting as the single exception in his memory the following fine lines from Clough:

"Come back! Come back!
Back flies the foam; the hoisted flag streams back,
The long smoke wavers on the homeward track,
Back fly with winds things which the winds obey,
The strong ship follows her appointed way."

The passage just quoted has been overlooked in Lady Scott's collection. There are other possible mistakes of both exclusion and inclusion, needless to mention in criticism of a selection in general so well made for its purpose. But since there is prose as well as verse in the volume, space should surely have been found for something from the famous classic "Two Years Before the Mast." Of a passage in this the poet Rogers used to say that it had "more poetry in it than most modern verse." One is almost tempted to add that the book has more genuine sea poetry in it than there is in most so-called poetry of the sea. A. F. W.

"A Review of Studies in Map Reading and Field Sketching." By Lieut. Colonel Wilkinson J. Shaw, P. S. C., M. A. 8 vo., pp. 146. (Published by E. P. Dutton & Company, New York.)

This little volume will be of interest principally to those officers who are not practiced in outdoor sketching and who feel the necessity of "brushing up" in this subject in order to pass creditably an examination for

promotion. Intelligence officers of the navy, unfamiliar with field sketching, whose duties may require of them the preparation of road or position sketches, will find it of no little value. The experienced topographer, however, will find the method of instruction assumed by Colonel Shaw rather tedious.

The book is written with a definite purpose, and the author carefully explains that it is not to be considered a text-book for the subject of which it treats. Its aim is to enable an officer to familiarize himself with the problems which confront a military topographer in the field and to give methods by which these difficulties may be overcome. Presupposing that the reader has learned the theory of the use and adjustment of simpler forms of surveying instruments, the author has written a diary covering seven days' field work with traverse board and plane table. Every operation in making road and position sketches is described in minute detail. The terrors of contouring, that bugaboo of the beginner, need excite no fear in the mind of the student who will carefully study the methods employed by Colonel Shaw.

The author of this very commendable work writes in such a clear and easy manner that it is to be hoped he will undertake the preparation of a more ambitious treatise on the general subject of "Military Topography." One knows, after reading "Studies in Map Reading and Field Sketching," that Colonel Shaw is an officer of unusual attainments with a peculiarly happy faculty of writing well. Such an engineer should be able to fill a long felt want, for it is an unfortunate fact that most of the obtainable text-books on military engineering and allied sciences are mediocre, both in arrangement and in text.

Among subalterns of the army and marine corps, this latest work of Colonel Shaw will find, if it is properly appreciated, a wide field of usefulness. Especially in the preparation for an examination for promotion (for which purpose the book chiefly was written), it cannot fail, when carefully read, to make the student more than usually proficient in map reading and field sketching.

J. M.

"Steam Engine Troubles." By H. Hawkins, M. E. (Published by The Norman W. Henly Publishing Company, New York.)

This book gives in one comparatively small volume a discussion of the advantages and disadvantages of many designs of stationary steam engines. It also treats fully the troubles to which they are liable and gives instructions for overcoming or minimizing them. These instructions for correcting faults are given in simple language, are easily understood, and where followed will prevent breakdowns and accidents.

The author gives directions for lining up engines, and erecting their foundations, for lubrication, valve setting and speed regulation, and for making proper adjustments on new engines and maintaining those on old ones. Chapters III, IV, V and XI, which cover piping and separators, throttle and emergency gears, pistons, and governors, having a general application will be found of particular interest to engineers both ashore and afloat.

The book is intended primarily for the operating engineer or prospective purchaser of stationery reciprocating steam engines, so will be found useful in any shore plant, but makes no attempt to enter the field of the marine or naval engineer. W. S. T.

"Koehler's West Point Manual of Disciplinary Physical Training." By Lieut. Colonel H. J. Koehler, U. S. Army. Price $2.00. (Published by Du Hon & Company.)

"Koehler's West Point Manual of Disciplinary Physical Training" is a well-written elementary treatise on physical training. The author has gone into his subject very carefully and has introduced some innovations. Mass commands have been used in training physical instructors, but Lieut. Colonel Koehler is a pioneer in adapting it for army use. It should be very valuable in training officers in the art of giving commands.

Lieut. Colonel Koehler's book, being in general a revision of Regulation No. 23, Field Training of The Soldier, now mandatory in army training, should be of much benefit to the country as a step toward standardized physical drill (along army lines) for colleges, preparatory schools, and lay institutions; hence, aiding universal preparedness. W. A. R.

NOTICE TO MEMBERS

More members, both regular and associate, are much desired. Any increase in membership invariably means larger number of papers and essays submitted, and consequently an improvement in the PROCEEDINGS.

You are requested to send or give the attached slip to some one eligible for membership, urging him to join.

By direction of the Board of Control,

G. M. RAVENSCROFT,
Secretary-Treasurer.

Attention is invited to extracts from the constitution on the opposite page as to the requirements in making applications for life, regular and associate membership. Members and associate members are liable for the payment of the annual dues until the date of the receipt of their resignation in writing. Annual dues $2.50.

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.....*191*

To the Secretary and Treasurer,
U. S. Naval Institute,
Annapolis, Md.

Dear Sir:

Please enroll my name as a { *regular* / *associate* } *member of the U. S. Naval Institute from this date.*

Very truly yours,

.....

.....

NOTICE

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It is now in its forty-sixth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control. To be declared elected, they must receive the affirmative vote of three-quarters of the members represented at regular or stated meetings, either in person or by proxy.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control. The Board of Control will at each regular meeting ballot on the nominations submitted for election, and nominees receiving a majority of the votes of the board membership shall be considered elected to membership in the United States Naval Institute."

Sec. 8. The annual dues for regular and associate members shall be two dollars and fifty cents, all of which shall be for a year's subscription to the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, payable upon joining the Institute, and upon the first day of each succeeding January. The fee for life membership shall be forty dollars, but if any regular or associate member has paid his dues for the year in which he wishes to be transferred to life membership, or has paid his dues for any future year or years, the amount so paid shall be deducted from the fee for life membership.

ARTICLE X

Sec. 2. One copy of the PROCEEDINGS, when published, shall be furnished to each regular and associate member (in return for dues paid), to each life member (in return for life membership fee paid), to honorary members, to each corresponding society of the Institute, and to such libraries and periodicals as may be determined upon by the Board of Control.

The PROCEEDINGS are published monthly; subscription for non-members, $3.00; enlisted men, U. S. Navy, $2.50. Single copies, by purchase, 30 cents; issues preceding January, 1919, 50 cents.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ESSAY, 1920

A prize of two hundred dollars, with a gold medal, and a life-membership (unless the author is already a life member) in the Institute, is offered by the Naval Institute for the best original essay on any subject pertaining to the naval profession published in the PROCEEDINGS during the current year. The prize will be in addition to the author's compensation paid upon publication of the essay.

On the opposite page are given suggested topics. Essays are not limited to these topics and no additional weight will be given an essay in awarding the prize because it is written on one of these suggested topics over one written on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. All original essays published in the PROCEEDINGS during 1919, which are deemed by the Board of Control to be of sufficient merit, will be passed upon by the Board during the month of January, 1920, and the award for the prize will be made by the Board of Control, voting by ballot.

2. No essay received after November 1 will be available for publication in 1919. Essays received subsequent to November 1, if accepted, will be published as soon as practicable thereafter.

3. If, in the opinion of the Board of Control, the best essay published during 1919 is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention," or such other distinction as the Board may decide.

4. In case one or more essays receive "Honorable Mention," the writers thereof will receive a minimum prize of seventy-five dollars and a life-membership (unless the author is already a life member) in the Institute, the actual amounts of the awards to be decided by the Board of Control in each case.

5. It is requested that all essays be submitted typewritten and in duplicate; essays submitted written in longhand and in single copy will, however, receive equal consideration.

6. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

G. M. RAVENSCROFT,
Commander, U. S. N., Secretary and Treasurer.

TOPICS FOR ESSAYS

SUGGESTED BY REQUEST OF THE BOARD OF CONTROL

"Duties and Responsibilities of Subordinates with Special Reference to the Relations between Commanders-in-Chief and Chief of Naval Operations; Commanders-in-Chief and Force Commanders; Force Commanders and Division Commanders."

"Initiative of the Subordinate—Its True Meaning."

"Military Efficiency Dependent upon National Discipline."

"Governmental Organization for War."

"Naval Gunnery, Now and of the Future."

"Naval Policies."

"The Place of the Naval Officer in International Affairs."

"Moral Preparedness."

"Tact in Relation to Discipline."

"The Principles of Naval Administration in Support of War-Time Operations."

"Responsibilities and Duties of Naval and Military Officers of the United States in Educating and Informing the Public on Professional Matters."

"A Commission in The Navy: Its Meaning and the Obligations Which It Involves."

"The Relations of an Officer to his Subordinate, Both Commissioned and Enlisted."

"The True Meaning of the Expression 'An Officer and a Gentleman.'"

"Seen in the Light of Recent Events, What Should Be the United States Navy of the Future as Regards Types and Numbers of Ships."

"Probable Future Development of Surface-craft, Air-craft and Submarines and the Relation of these Types to Each Other and to Naval Warfare in General."

"The Grand Strategy of the Great War, with Especial Reference to Coördination, and Lack of Coördination, Between Naval and Military Forces."

"The Problem of Overseas Operations in the Light of Recent Developments."

"The Influence of Sea Power upon History as Illustrated by the Great War."

LIST OF PRIZE ESSAYS

"WHAT THE NAVY HAS BEEN THINKING ABOUT"

1879

Naval Education. Prize Essay, 1879. By Lieut. Commander A. D. Brown, U. S. N.

Naval Education. First Honorable Mention. By Lieut. Commander C. F. Goodrich, U. S. N.

Naval Education. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881

The Type of (I) Armored Vessel, (II) Cruiser Best Suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

Second Prize Essay, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882

Our Merchant Marine: The Causes of Its Decline and the Means to Be Taken for Its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. Kelley, U. S. N.

"Mais il faut cultiver notre jardin." Honorable Mention. By Master C. G. Calkins, U. S. N.

"Spero meliora." Honorable Mention. By Lieut. Commander F. E. Chadwick, U. S. N.

"Causa latet: vis est notissima." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883

How May the Sphere of Usefulness of Naval Officers Be Extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"Semper paratus." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"Cuilibet in arte sua credendum est." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886

What Changes in Organization and Drill Are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

The Result of All Naval Administration and Efforts Finds Its Expression in Good Organization and Thorough Drill on Board of Suitable Ships. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887

The Naval Brigade: Its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888

Torpedoes. Prize Essay, 1888. By Lieut. Commander W. W. Reisinger, U. S. N.

1891

The Enlistment, Training and Organization of Crews for Our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

Disposition and Employment of the Fleet: Ship and Squadron Drill. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892

Torpedo-boats: Their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894

The U. S. S. Vesuvius, with Special Reference to Her Pneumatic Battery. Prize Essay, 1894. By Lieut. Commander Seaton Schroeder, U. S. N.

Naval Reform. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut. Commander Richard Wainwright, U. S. N.

A Summary of the Situation and Outlook in Europe. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

Suggestions for Increasing the Efficiency of Our New Ships. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

The Battle of the Yalu. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

The Organization, Training and Discipline of the Navy Personnel as Viewed from the Ship. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

Naval Apprentices, Inducements, Enlisting and Training. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

The Composition of the Fleet. Honorable Mention 1896. By Lieutenant John M. Ellicott, U. S. N.

1897

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A Proposed Uniform Course of Instruction for the Naval Militia. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

Torpedoes in Exercise and Battle. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut. Commander Richard Wainwright, U. S. N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903

Gunnery in Our Navy. The Causes of Its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure Its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904

The Fleet and Its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905

American Naval Policy. Prize, Essay 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear Admiral Stephen B. Luce, U. S. N.

1906

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut. Commander A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906 By Pay Inspector J. A. Mudd. U. S. N.

1907

Storekeeping at the Navy Yards. Prize Essay, 1907. By Pay Inspector John A. Mudd, U. S. N.

BATTLE REHEARSALS. A Few Thoughts on Our Next Step in Fleet-Gunnery. First Honorable Mention, 1907. By Lieut. Commander Yates Stirling, U. S. N.

THE NAVAL PROFESSION. Second Honorable Mention, 1907. By Commander Bradley A. Fiske, U. S. N.

1908

A Few Hints to the Study of Naval Tactics. Prize Essay, 1908. By Lieutenant W. S. Pye, U. S. N.

THE MONEY FOR THE NAVY. First Honorable Mention, 1908. By Pay Inspector John A. Mudd, U. S. N.

THE NATION'S DEFENCE—THE OFFENSIVE FLEET. How Shall We Prepare It for Battle? Second Honorable Mention, 1908. By Lieut. Commander Yates Stirling, U. S. N.

1909

Some Ideas about Organization on Board Ship. Prize Essay, 1909. By Lieutenant Ernest J. King, U. S. N.

THE NAVY AND COAST DEFENCE. Honorable Mention, 1909. By Commodore W. H. Beehler, U. S. N.

THE REORGANIZATION OF THE NAVAL ESTABLISHMENT. Honorable Mention, 1909. By Pay Inspector J. A. Mudd, U. S. N.

A PLEA FOR PHYSICAL TRAINING IN THE NAVY. Honorable Mention, 1909. By Commander A. P. Niblack, U. S. N.

1910

The Merchant Marine and the Navy. Prize Essay, 1910. By Naval Constructor T. G. Roberts, U. S. N.

THE NAVAL STRATEGY OF THE RUSSO-JAPANESE WAR. Honorable Mention, 1910. By Lieutenant Lyman A. Cotton, U. S. N.

1911

Navy Yard Economy. Prize Essay, 1911. By Paymaster Charles Conard, U. S. N.

NAVAL POWER. Honorable Mention, 1911. By Captain Bradley A. Fiske, U. S. N.

WANTED—FIRST AID. Honorable Mention, 1911. By Commander C. C. Marsh, U. S. N.

1912

Naval Might. Prize Essay, 1912. By Lieutenant Ridgely Hunt, U. S. N. (retired).

INSPECTION DUTY AT THE NAVY YARDS. Honorable Mention, 1912. By Lieut. Commander T. D. Parker, U. S. N.

1913

The Greatest Need of the Atlantic Fleet. Prize Essay, 1913. By Lieut. Commander Harry E. Yarnell, U. S. N.

NAVY DEPARTMENT ORGANIZATION. A Study of Principles. First Honorable Mention, 1913. By Commander Yates Stirling, Jr., U. S. N.

TRAINED INITIATIVE AND UNITY OF ACTION. Second Honorable Mention, 1913. By Lieut. Commander Dudley W. Knox, U. S. N.

1914

The Great Lesson from Nelson for To-day. Prize Essay, 1914. By Lieut. Commander Dudley W. Knox, U. S. N.

NAVAL POLICY AS IT RELATES TO THE SHORE ESTABLISHMENT AND THE MAINTENANCE OF THE FLEET. Honorable Mention, 1914. By Captain John Hood, U. S. N.

OLD PRINCIPLES AND MODERN APPLICATIONS. Honorable Mention, 1914. By Lieut. Commander Dudley W. Knox, U. S. N.

MILITARY PREPAREDNESS. Honorable Mention, 1914. By Naval Constructor Richard D. Gatewood, U. S. N.

1915

The Rôle of Doctrine in Naval Warfare. Prize Essay, 1915. By Lieut. Commander Dudley W. Knox, U. S. N.

AN AIR FLEET: OUR PRESSING NAVAL WANT. First Honorable Mention, 1915. By Lieut. Commander Thomas Drayton Parker, U. S. N.

TACTICS. Second Honorable Mention, 1915. By Ensign H. H. Frost, U. S. N.

DEFENCE AGAINST SURPRISE TORPEDO ATTACK. Third Honorable Mention, 1915. By Ensign R. T. Merrill, 2d, U. S. N.

1916

The Moral Factor in War. Prize Essay, 1916. By Lieutenant (J. G.) H. H. Frost, U. S. N.

NAVAL PERSONNEL. First Honorable Mention, 1916. By Lieut. Commander J. K. Taussig, U. S. N.

EDUCATION AT THE U. S. NAVAL ACADEMY. Second Honorable Mention, 1916. By Lieutenant Ridgely Hunt, U. S. N.

SOME UNDERLYING PRINCIPLES OF MORALE. Third Honorable Mention, 1916. By Commander Dudley W. Knox, U. S. N.

LARGE *vs.* A GREATER NUMBER OF SMALLER BATTLESHIPS. Lippincott Prize Essay. By Lieut. Commander Thomas Lee Johnson, U. S. N.

1917

Commerce Destroying in War. Prize Essay, 1917. By Commander Lyman A. Cotten, U. S. Navy.

THE PEOPLE'S RÔLE IN WAR. First Honorable Mention, 1917. By Lieutenant H. H. Frost, U. S. Navy.

THE NATION'S GREATEST NEED. Second Honorable Mention, 1917. By Colonel Dion Williams, U. S. Marine Corps.

1918

Letters on Naval Tactics. Prize Essay, 1918. By Lieutenant H. H. Frost, U. S. N.

THE PREPAREDNESS OF THE FUTURE. First Honorable mention, 1918. By Commander H. O. Rittenhouse, U. S. N. Retired.

NAVAL STRATEGY. Second Honorable Mention, 1918. By Rear Admiral Bradley A. Fiske, U. S. N.

1919

MILITARY CHARACTER. First Honorable Mention, 1918. By Captain Reginald R. Belknap, U. S. N.

SOME REFLECTIONS ON THE THREE FACTORS OF BATTLESHIP DESIGN. Second Honorable Mention, 1918. By Lieut. Commander Beirne S. Bullard, C. C., U. S. N.